

[Price 10s.

PROCEEDINGS
OF
THE LINNEAN SOCIETY OF LONDON



147TH SESSION

FROM OCTOBER 1934 TO MAY 1935

LONDON:

PRINTED FOR THE LINNEAN SOCIETY OF LONDON,

BURLINGTON HOUSE, PICCADILLY, W. 1.

BY TAYLOR AND FRANCIS, RED LION COURT, FLEET STREET.

THE LINNEAN SOCIETY OF LONDON.

LIST OF OFFICERS AND COUNCIL.

1935-36.

PRESIDENT.

Dr. William Thomas Calman, O.B., F.R.S.

VICE-PRESIDENTS.

Prof. G. D. Hale Carpenter, M.B.E.
Mr. Francis Druce.

Dr. Margery Knight.
Prof. Macgregor Skene.

TREASURER.

Mr. Francis Druce.

SECRETARIES.

Botanical.

Mr. J. Ramabottom, O.B.E.

Zoological.

Dr. Stanley Kemp, F.R.S.

COUNCIL.

The Lord Aberconway, C.B.E.
Dr. Eric Ashby.
Dr. B. Barnes.
Dr. W. T. Calman, O.B., F.R.S.
Prof. G. D. Hale Carpenter, M.B.E.
Mr. Francis Druce.
Mr. S. Garside.
Dr. J. Hutchinson.
Mr. H. A. Hyde.
Dr. Stanley Kemp, F.R.S.
Dr. Margery Knight.

Mr. Ashley G. Lowndes.
Prof. E. W. MacBride, F.R.S.
Mr. J. Ramabottom, O.B.E.
Dr. Hugh Scott.
Mr. D. J. Secourfield, I.S.O.
Lt.-Col. R. B. Seymour Sewell, C.I.E.,
F.R.S.
Prof. Macgregor Skene.
Mr. W. H. Wilkins.
Dr. E. B. Worthington.

LIBRARIAN AND ASSISTANT SECRETARY.

Mr. Spencer Savage.

PROCEEDINGS
OF
THE LINNEAN SOCIETY OF LONDON



147TH SESSION

FROM OCTOBER 1934 TO MAY 1935

LONDON:

PRINTED FOR THE LINNEAN SOCIETY OF LONDON,
BURLINGTON HOUSE, PICCADILLY, W.1.

1935

THE LINNEAN SOCIETY OF LONDON

PATRON

HIS MOST EXCELLENT MAJESTY THE KING,
EMPEROR OF INDIA.

HONORARY MEMBERS

HER MOST EXCELLENT MAJESTY
QUEEN MARY, L.G.

H.R.H. THE PRINCE OF WALES, K.G., F.R.S.

HIS MAJESTY LEOPOLD III.,
KING OF THE BELGIANS.

HIS IMPERIAL MAJESTY THE EMPEROR
OF JAPAN, K.G.

HIS MAJESTY GUSTAV V., KING OF SWEDEN, K.G.

CONTENTS

	Page
List of Publications issued	iv
Proceedings of the 147th Session	i
Presidential Address	145
Obituaries	159
Benefactions, 1915-1935.....	198
Treasurer's Accounts	204
Additions and Donations to Library	208
Index	214

PUBLICATIONS : FROM JUNE 1934-MAY 1935

Journal, Botany.

Vol. XLIX. No. 331.
„ 332.

Journal, Zoology.

Vol. XXXIX. No. 263.
„ 264.
„ 265.

Proceedings, 146th Session, 1933-34.

List of The Linnean Society of London, Oct. 1934.

Catalogue of the Manuscripts in the Library . . .

Part I.—The Smith Papers. By WARREN R. DAWSON.

PROCEEDINGS

OF

THE LINNEAN SOCIETY OF LONDON

(ONE HUNDRED AND FORTY-SEVENTH SESSION,
1934-35)

GENERAL MEETINGS

25 OCTOBER 1934

Dr. W. T. CALMAN, F.R.S., President,
in the Chair

The Proceedings of the Anniversary Meeting held on Thursday, 24 May 1934, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted :—Patrick Martin Hall, John Spedan Lewis and Sir Albert Howard, C.I.E.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Geoffrey John Kerrich ; for the first time, in favour of Francis Hemming, C.B.E., William Thomas Stearn, George Osborne King Sainsbury, Comyns John Augustus Berkeley, Edmund Fredric Warburg, John Hemsworth Osborne Day, Salvatore Louis Vella, Arthur Knyvett Totton and George Eric Howard Foxon.

The President reported the deaths of John Edgar Beckett, Ethelbert Blatter, George Francis Scott Elliot, Leonard Cockayne, George Fry, Robert Francis Scharff, Sushil Kumar

Issued 6 March 1935]

Mukerji, Sir Arthur R. F. Dorward, K.C.B., D.S.O., Ellen Ann Willmott, Edward Berkeley Wilkinson, Otto Vernon Darbishire and Sydney Turner Klein, Fellows of the Society, and of Nathaniel Lord Britton, Foreign Member.

Dr. STANLEY KEMP, on behalf of Mr. H. W. LAWTON, showed some specimens of *Peripatoides novae-zealandiae* from New Zealand.

Mr. S. SAVAGE exhibited the following donations recently received from the Misses PHIPPS TIARKS:—(1) A portrait in water colours of NATHANIEL BAGSHAW WARD, F.R.S., F.L.S. (1791–1868); (2) a lithograph from Knight's portrait of Ward in the Society's Rooms; (3) a pen-and-ink drawing by Miss Maria Ward of part of her father's conservatory at Wellclose Square; (4) a specimen of moss (*Fissidens bryoides* Hedw.) attached to a printed extract from Mungo Park's Travels—apparently distributed by Ward to his friends; and (5) Ward's medal as a member of the Pitt Club. These were bequeathed by Miss Maria Ward to Charles Phipps Tiarks, the father of the present donors, whose great-uncle was Johann Ludwig Tiarks, F.R.S., an astronomer who was for a time an assistant librarian to Sir Joseph Banks.

A short account of Ward's life and his invention of the Wardian Case was also given.

Dr. A. B. RENDLE mentioned that Dr. Ward's herbarium was now incorporated with the British Museum Herbarium. It was purchased from the executors in 1869 and contained nearly 7000 specimens, including over 3000 from various South African collectors. The specimens were sewn on small square blue sheets, and it was reported that Mrs. Ward's tea-parties took the form of sewing meetings. Dr. Braithwaite, the eminent British bryologist, married Ward's daughter and continued his medical practice for many years in his house at Clapham Rise. The house was jettisoned for modern improvements more than thirty years ago.

A special vote of thanks was accorded to the donors, the Misses Phipps Tiarks.

Studies in Floral Anatomy.—II. The floral anatomy of *Glaucium flavum* with reference to other members of the Papaveraceae. By Miss JEAN DICKSON (Visitor).

A BRIEF account was given of certain outstanding cases in the Papaveroideae to show the progress of carpel differentiation. Particular note was made of a series of 4-carpellary types, namely, *Glaucium flavum* Cr., *Sanguinaria canadensis*

L., *Chelidonium majus* L., *Macleaya cordata* (Willd.) R. Br., and *Eschscholtzia caespitosa* Benth., which show the contraction of the fertile carpels from comparatively wide ribs, with several vascular strands, to narrow cords each with a single bundle.

The structure of the gynaecium in these types is comparable with that of certain Crucifers described by Miss Saunders and by Eames and Wilson.

Dr. A. B. RENDLE congratulated the speaker on her excellent and instructive series of sections illustrating the floral anatomy of the Papaveroideae, which had an important bearing on the presumed quadripartite character of the ovary. He regretted that Miss Saunders was not present to speak on the subject of the paper.

Prof. E. W. MACBRIDE made some remarks.

Dr. HAMSHAW THOMAS said that Miss Dickson had presented some very interesting information and had brought out a number of points which seemed difficult to explain in accordance with our older morphological ideas. Her evidence for the idea that the lobes of the stigmas in *Sanguinaria* were formed by the fusion of one carpel with the adjacent halves of two other carpels was interesting in connexion with the subject of stigma structure. There was little doubt that several diverse interpretations might be given to facts like those presented, but if we were provided with a series of careful studies like those of Miss Dickson, we might eventually be able to decide which explanation fitted all the facts most easily and most completely.

Miss DICKSON replied.

Report on the South African Polychaeta.

By Dr. J. H. DAY (Visitor).

THE first important work on the South African Polychaeta was that of Schmarda, 1861. There followed McIntosh's paper on the *Challenger* collection and the two collections of Dr. Gilchrist. Other important works are those of Willey 1904, Ehlers 1908 and 1913, Augener 1918, and Monro 1930.

The region is bounded on the north by tropical conditions in Angola and Mosambique. There are two main coastal currents, the warm Mosambique current flowing down the east coast and the cold Benguela current flowing up the west coast. Maximum temperatures are obtained along the Natal (eastern) coasts. Values fall towards Cape Agulhas and continue to fall as the Benguela current is traced northwards, minimum values being obtained near Luderitzbucht. In 1930 a maximum temperature of 23°·4 C. was recorded at Durban and a minimum of 10°·1 C. near Luderitzbucht.

If the South African seas are divided by a longitudinal meridian through Cape Agulhas, the average yearly temperature of the east coast is $17^{\circ}.1$ C. as against $13^{\circ}.7$ C. of the west coast.

Besides temperature the influence of two other factors may be noted. An absence of promontories or large bays coupled with the narrowness of the continental shelf allows the full strength of oceanic waves to be felt all along the coast-line. Exposure is a limiting factor in the fauna of sand banks and surf beaches, but at the Cape this effect is diminished both by cooler conditions and increased algal growth.

The fauna may be divided ecologically in two ways:

1. Tropical, subtropical, and temperate species. This division is at present impracticable owing to paucity of records.

2. East and west coast faunas. Allowing for a region of overlap between Table Bay and False Bay it is found that 40 per cent. of the Polychaetes are limited to the west coast and 42 per cent. to the east coast, while 18 per cent. are common to both regions.

It thus appears that a greater number of species are peculiar to each region than are common to both. The 18 per cent. are made up as follows: 5 per cent. are universal in distribution and are mainly errant species. The remaining 13 per cent. are peculiar to South Africa and are mainly burrowing or tubicolous forms.

The coast may be divided into locality-types.

Most of the coast-line falls under the head of open surf beaches and must be subdivided into (i) sandy beaches with a poor Polychaete fauna mainly consisting of burrowing forms, (ii) rocky beaches or cliffs with incrusting or clinging forms, and (iii) a mixture of both, the low tide revealing reefs with intersecting sandy gullies and pools. The last is the most general type and is thickly populated with all forms of Polychaetes.

There are also a number of lagoons, broad shallow estuaries with sandy or muddy banks and bars. Where these are exposed to the hot sun the fauna is limited to burrowing forms, but in sheltered places or in temperate climes lagoons are prolific in burrowing or tubicolous forms.

Many species, of which *Sabellastarte longa* is an example, are interesting systematically. This species seems to be the South African representative of the European *Bispira volutacornis*, resembling it in form and habits and differing only in the absence of certain pick-axe bristles. *Perinereis variegata* is distributed all along the South African coasts. Normally errant, it burrows in sandy localities and lives in the crevices of barnacle colonies on rocky cliffs. Colonies of *Gunnarea capensis* form enormous masses of sandy tubes, within the interstices of which live a host of marine animals. Within

the tubes are commensals, notably *Polynoe scolopendrina*, which in Europe is a commensal of other Polychaetes. A fine example of protective imitation is afforded by *Audouinia filifera* var. *capensis*. The body is coiled and buried in the sand, so that the protruding tentacles and branchiae resemble those of an anemone.

The PRESIDENT, in thanking Dr. Day for his paper, asked whether there was any evidence of asexual reproduction in the tubicolous species which appeared to have a colonial habit.

Dr. DAY replied that there was no such evidence in *Gunnareia capensis*, the species shown in his photographs. The larvae were excessively abundant in the plankton at certain seasons, and the masses of tubes shown were apparently due to great numbers of the larvae settling in one place. The lumina of individual tubes of a colony were not connected.

In reply to a question by Professor MacBride, Dr. DAY agreed that errant forms often had burrowing habits.

Foetal and Post-natal coats of the Antelopes of the subfamily Tragelaphinae. By Capt. J. GUY DOLLMAN.

A SERIES of foetal and adult skins of the Antelopes of the subfamily Tragelaphinae were exhibited to illustrate (1) that the foetal colour and pattern is retained in the adult stage in some genera, in others either the colour or colour and pattern is retained in the female sex only, and in the other genera the pattern is retained, but the colour is lost, (2) that the Indian members of the group, the Nilgai (*Boselaphus*) and the Four-horned antelope (*Tetraceros*), are unstriped both in the foetal and adult stage.

In view of the marked differences between the Indian and the African members of the subfamily, it was proposed that the two groups should be separately considered as of subfamily rank, the African genera forming the subfamily Tragelaphinae and the two Indian genera and species forming the subfamily Boselaphinae. In addition to the difference already indicated between these two groups, it was further pointed out that they differed in the following respects:—Firstly, the African Tragelaphines possess no face glands, whereas well-formed face glands are present in the Nilgai and Four-horned antelopes; and, secondly, the horns in the African members are all spirally twisted and of considerable length, while in the Indian section the horns are short and nearly straight, showing but little tendency to curve.

As regards the Tragelaphinae, that is the African forms alone, it was pointed out that the foetal pattern and colour persisted throughout life in the Bushbucks and Bongos, although in certain specimens and species the original fawn

colour of the foetus turned considerably darker. The foetal coat of the mountain Bushbuck, *Tragelaphus buxtoni* was shown to be similarly striped to that of the true Bushbuck, but the markings disappear in the adult with the exception of the tragelaphine chevrons, and a small number of spots on the face and hind quarters. On account of the great difference of bodily size and shape of the horn, it was suggested that this antelope should properly be considered as representing a genus distinct from that of the Bushbucks.

The Nyala was considered as representing a distinct genus, *Nyala*, a name provided by Edmund Heller some years back. The colour changes of the male Nyala from bright buff to dark brownish grey with partial loss of the body pattern and the retention of the colour and pattern in the female sex were noted.

In the genus *Limnotragus* one species was observed to lose the colour and pattern in both the male and female sex, while in another group the bright rufous colour of the foetal skin was retained in the females, the white striping, so characteristic a feature of the foetus, disappearing with advancing age. The Kudus (*Strepsiceros*), the lesser Kudus (*Ammelaphus*), and the Elands (*Taurotragus*) were all shown to have richly coloured fully striped foetal phases, the striping persisting to a certain extent in all three genera, but the colour changing from reddish fawn to greyish buff.

The PRESIDENT commented on the interest of this exhibit, especially as regards the retention in foetal and young animals of generalized characters which were obscured or lost in the adults.

Mr. J. SPEDAN LEWIS added some remarks.

8 November 1934

Dr. W. T. CALMAN, F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 25 October 1934, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

Certificates of recommendation of the following candidates for Fellowship were read: For the second time, in favour of Francis Hemming, C.B.E., William Thomas Stearn, George Osborne King Sainsbury, Comyns John Augustus Berkeley, Edmund Fredric Warburg, John Hemsworth Osborne Day,

Salvatore Louis Vella, Arthur Knyvett Totton and George Eric Howard Foxon; for the first time, in favour of Cecil Thomas Prime.

The President reported the deaths of Rupert Vallentin, F.L.S., Prof. Henri Lecomte, F.M.L.S., and James Lomax, A.L.S.

The Loch Ness 'Monster'.

By Sir EDWARD M. MOUNTAIN, Bt., J.P. (Visitor).

I do not intend to lecture to you about the creature in Loch Ness, but simply to give you a brief story of the events of my expedition prior to the film being taken. I leave you to judge the film for yourselves.

I had always been interested in the mystery from the first accounts which appeared in the papers about two years ago, and during the first few days I was in Scotland was very impressed by the stories I heard from people whom I felt I could rely upon. I had also read with much interest Commander Gould's book, and on the first Sunday of my holiday when motoring round the Loch it struck me that, with the exception of an attempt by a certain newspaper some time before no properly organised search had been made. It occurred to me that if some twenty watchers were placed round the Loch at points of vantage, armed with cameras and binoculars, and stationed so that their positions interlocked across the Loch, it could be determined very readily whether there was really some large creature there, as more or less the whole of the Loch would be under observation at the same time.

By the time evening arrived I determined to undertake the search myself. I therefore obtained twenty unemployed men who might be considered suitable for the work, such as ghillies and keepers, and put them under the charge of Captain Fraser, an ex-officer of the Camerons, who was responsible for marshalling the men in the morning and taking them by motor-coach to their allotted stations and generally supervising them.

Loch Ness is approximately $22\frac{1}{2}$ miles long and not more than $2\frac{1}{2}$ miles in width. There is a legend that it is unfathomable, but this is untrue, as careful soundings were taken some years ago and the greatest depth, which is off Urquhart Castle, is 750 feet and the average is about 500 feet.

If there were a creature in the Loch, the question arose as to how it got there, for unless it had travelled overland there are only three possible entrances:—the first and second by the Canal at each extremity of the Loch and the third by the Ness River. It has been suggested that there are subterranean caverns which connect with the sea, but this.

cannot be so as the water in Loch Ness is absolutely fresh and stands at fifty to sixty feet above sea-level.

Both canals are constructed with locks which afford a passage for small steamers and fishing boats, and it is almost inconceivable that a creature of any size could have got through these locks at the time a steamer was passing (the gates are kept closed otherwise) without being spotted. We are therefore left with the conclusion that it came via the river. There are two weirs in the Ness River, and it is only when the river is in spate that a creature of any size could get up them without going on land. When the river is in spate, it is estimated that an animal drawing five feet of water could navigate the weirs. It is quite possible that the creature waited at the mouth of the Ness River, feeding on the salmon, which appears to be the only suitable food, and that when the spate came and the salmon went up stream it followed them up until it entered the Loch. It has remained there, either because it cannot find its way out or because it is content with its present surroundings.

In the beginning of July when the search began, the weather was ideal for the watchers—still, bright, sunny weather which made the Loch glassy and easy to observe. On the very first day the creature was seen, and altogether during the first fortnight was observed by my watchers no less than seventeen times. They also secured several photographs, some of which appeared in *The Times* and other leading papers. These, whilst disappointing in a way, show a wash which it seems inconceivable could have been made by other than a large creature.

The evidence of my watchers is that six describe the creature as having two or three or more humps, only one describes it as having one hump, four describe it as having a long neck, four describe it as causing great commotion in the water with a heavy wash, and nearly all describe the colour as dark brown or black. Where a description of the skin is given it is described as rough. Fourteen describe it as being between fourteen and fifteen feet long.

Besides the photographs I was able to secure there is a very interesting one taken by Mr. Wilson of Harley Street, which was published some time ago in the *Daily Mail*. This shows a large projection in the water which might be a head or neck or a dorsal fin. If it were the latter the animal is certainly not a member of the seal family, but might be some species of whale or such-like creature which could live in fresh water. However, this cannot be reconciled with the evidence of the three people who claim to have seen the creature ashore. It was suggested by an eminent zoologist that the photograph taken by Mr. Wilson might be a cormorant diving

in the water. Mr. Wilson, however, observed this protuberance for several minutes and he is naturally not likely to agree with this suggestion.

On 15th September last Captain Fraser, my supervisor, was able to obtain a short film of the creature from Urquhart Castle with a Kodak cine-camera fitted with a 6-inch telephoto lens. The film was taken at 7.15 a.m. and the animal was from three-quarters of a mile to a mile distant. It was misty and dull and Capt. Fraser feared that very little would come out on the film. However, in spite of the poor light which made photography extremely difficult, the film quite clearly shows the creature swimming across the Loch.

Captain Fraser describes it as about fifteen feet long, as did also the custodian of Urquhart Castle, who was present at the time. They reported it as dark brown, and when first seen it appeared to be basking on the surface of the water.

In summing up the evidence, I would ask you to consider the possibility of its being a grey seal. That is a creature which could easily live in a fresh-water loch, where there is plenty of food, such as salmon. The grey seal swims rapidly, which is in accordance with observation, and the humps that are seen might be the wash created when it was swimming fast and a seal might evidently have been seen on land. Also, a large grey seal would be little smaller than the length described by many of the witnesses.

Against the supposition that it is a grey seal is the fact that none of the witnesses have described it as like a seal. Many of the witnesses are acquainted with the appearance and habits of seals, and they declare emphatically it is not a seal. There is, too, the fact of its extreme shyness, and that it has never been heard barking. There is the curious photograph of Mr. Wilson, and the amazing fact that it has practically never been seen on land or basking, except on the three occasions reported in the papers. The length of the creature as recorded by some witnesses would prohibit its being a seal, and the numerous reports as to the long thin neck and small head would not coincide with such a theory.

Therefore, I have been able to solve only one thing, that is that the Loch Ness monster is not a myth, that there is some large and unusual inhabitant of the Loch. The problems remaining to be solved are, firstly, the exact nature of this creature and, secondly, is there more than one creature of the same or different species in the Loch.

Sir Edward Mountain then exhibited the film, in which the short section taken by Capt. Fraser was repeated a number of times. In spite of the difficulties noted above, the animal

and the wash that it made as it moved rapidly at the surface were seen with surprising clearness.

Lieut.-Commander R. T. GOULD remarked that he was not a zoologist, and would have preferred to withhold his views until the various zoologists present had offered theirs.

He had twice visited Loch Ness—in November 1933 and October 1934—to obtain evidence. On the former occasion he took independent statements from fifty-six eye-witnesses, and was much impressed by their consistency and by the obvious honesty and caution of the witnesses. On this evidence, the Loch Ness creature was well above thirty feet in total length, and possessed a long thin neck, while its body sometimes appeared as a large, smooth (finless), single hump, and at other times as a series of smaller humps. These conclusions were supported by the photographs obtained by Mr. R. K. Wilson, F.R.C.S., and others (including Sir E. Mountain's watchers) as well as by the film they had just seen.

He did not believe the creature to be indigenous, although it had apparently been seen in the Loch on various occasions since 1923, and possibly earlier. He had little doubt that it had made its way up the River Ness during a spate.

With regard to its identification, some of the theories mooted in the Press were, in his judgment, obviously absurd. It had, however, been contended with some plausibility that the creature was either a small whale or a large seal. The apparent long neck in Mr. Wilson's photograph had been claimed to be the dorsal fin of a 'killer' whale—but it curved the wrong way; and, in addition, so large and prominent a fin could not possibly have escaped the attention of the many witnesses who had seen the creature in its most usual aspect, that of a single, large, finless hump.

The seal theory was open to the obvious objection that no seal, or even the Antarctic sea-elephant, attained anything approaching the creature's reported size. Lt.-Commr. Gould instanced the observations made at short range (400 yds.) under excellent conditions of observations, by a trained naval surveyor, accustomed to judge of the size, distance, and outline of objects seen over water—Capt. F. E. B. Haselfoot, R.N. This officer stated that the creature exhibited two humps in line, each about six to eight feet long and about the same distance apart. Some distance in front of the leading hump, a long thin neck carrying a somewhat larger head was occasionally elevated above water. He also cited the very similar observations made by Mr. D. W. Morrison, Mr. B. A. Russell, M.A., and others, and borne out by Mr. Wilson's photograph.

Many of the witnesses he had interviewed were exceedingly familiar with the appearance of all British species of seal, and were quite positive that the creature they saw was not one. He mentioned that the editor of an Inverness paper had remarked to him 'Some of the London scientists seem to think that our people up here are all half-witted, and don't know a seal when they see it. Actually, many of them see more seals in a month than most Londoners do in their whole lives.'

He concluded by drawing attention to some curious parallels between the evidence he had obtained and that collected by another Linnean Society—that of Boston, U.S.A.—respecting a strange creature observed on many occasions in the harbour of Gloucester, Mass., in 1817; and to the fact that similar long-necked creatures had been seen by competent witnesses in the Sound of Sleat (in 1872 and 1893) as well as in many other parts of the world.

Sir SIDNEY HARMER expressed the opinion that the movements of the animal shown by the film were not of a kind which may be observed in Cetacea. He remarked that the high dorsal fin of the Killer Whale, several times referred to in newspaper accounts, as well as during the Meeting, is only present in old males; the females of this species having a recurved and much lower dorsal fin. He had had no experience of living Grey Seals, but he was inclined to think that the animal might belong to that species.

Mr. M. A. C. HINTON said he had no doubt that the living creature shown in the film was a seal; its movements exactly resembled those of the Grey Seals which he saw at certain times of the year in the Dornoch Firth, on calm days chasing salmon and other fish. He thought the film showed a seal jumping half out of the water after fish which had jumped out.

The Loch Ness 'Monster' was a compound of at least three things: firstly, the living creature shown in the film, i.e. in his own view a seal; secondly, erroneous observation of various objects, animate and inanimate; and, thirdly, tradition and superstition.

Dr. STANLEY KEMP stated that he had never seen a seal swim in the same way as the creature shown in the film. During the present year he had had many opportunities of observing grey seal on the coasts of Co. Kerry. These seal constantly hauled up on rocks at ebb tide and spent hours out of water. If the animal in Loch Ness were a grey seal it is probable that its habits would be similar, and in that event it would often have been seen at close quarters and its identity established. He was also convinced that the creature was not a Cetacean.

Mr. F. C. FRASER disagreed with Dr. Kemp. He thought the movements of the animal were reminiscent of those of seals which he had observed in South Georgia. Even if the animal shown in the film were a seal it did not necessarily follow that it was the Loch Ness monster.

Sir A. SMITH WOODWARD said there was no basis for the supposition that the strange animal in Loch Ness might be a surviving Mesozoic reptile. If any of the typically Mesozoic sea reptiles had lived until later times, their remains would ere this have been found in marine Tertiary formations in some part of the world. There were no such traces of them. He feared that the animal could not be satisfactorily identified until it died and at least part of it could be examined.

Mr. T. B. BLOW thought that good results might be obtained by photographing the animal from an aeroplane, using a telephoto lens and infra-red plates.

Dr. G. P. BIDDER made some remarks.

Captain J. GUY DOLLMAN remarked that he was sorry to pour cold water on the ceremony, but he was convinced that the photograph of the animal they had seen upon the screen was nothing less and nothing more than that of a common Otter. The movements of the animal upon the surface of the water were undoubtedly those of an Otter, and did not appear to him to be in any way like the movements of a seal.

Mr. A. J. WILMOTT suggested that the size of the object might be estimated by comparison with the height of the lake-side trees behind it. The length of the part of the beast represented in the film appeared to be about one-tenth that of the height of the plants, which would not be more than 30 feet. Even allowing for the oblique position of the beast its size would not be as great as Messrs. Kodak's estimate of 8 feet for the part visible above water.

The PRESIDENT, remarking that this was the first occasion on which the Loch Ness 'Monster' had been under consideration by a scientific society, expressed the thanks of the meeting to Sir Edward Mountain for giving them the opportunity of seeing this very remarkable film.

[*Note.*—Sir Edward Mountain has since explained that the film was taken from the knoll behind Urquhart Castle, looking northwards across Urquhart Bay. The creature was evidently somewhere near the far shore, and the first estimates put the distance at between 1500 and 1700 yards. Commander Gould has since visited the spot and was shown the position of the camera and the presumed position of the animal in the water. He worked out the distance and found it to be approximately 1625 ± 50 yards. At this range the Kodak Company estimate that the visible part of the animal seen in the film is 8 feet in length.]

On some Linnaean species.

By Dr. A. B. RENDLE, F.R.S.

FAILURE to consult original specimens has led to some confusion in the nomenclature of species of *Spermacoce*. The original genus, Linnaeus, Sp. Pl. i. 102, contained three species, *S. tenuior*, *S. verticillata*, and *S. hispida*. The second was subsequently separated by G. F. W. Meyer (Prim. Flor. Esseq. 81; 1818) under his genus *Borreria*, and there is no doubt as to its identity. The Linnean herbarium does not help; it contains a sheet written up (by Solander) as *Spermacoce tenuior* and indicated by Linnaeus as coming from Patrick Browne. The sheet contains two specimens, neither of which belongs to *Spermacoce* as now restricted; one is *Borreria spinosa* Cham. & Schlecht., the other *Hemidiodia ocimifolia* K. Sch. But they have no bearing on the definition by Linnaeus, as he did not receive Browne's specimens until 1758.

Linnaeus cites three references: (1) Dillenius, Hort. Elth. 370, t. 227, f. 359; (2) Royen, lugdb. 258; (3) Plukenet, Almagesta, 33, t. 136, f. 4.

(1) Dillenius's figure has generally been regarded as representing a North American species *Spermacoce glabra* Michx. The specimen was listed by Druce (Druce & Vines's 'The Dillenian Herbaria') as not found in the Dillenian herbarium at Oxford, but with the help of the Curator, Mr. H. Baker, I found a specimen in Sherard's herbarium which is evidently the plant figured by Dillenius. It represents the species which, under the name *S. glabra* Michx., has been regarded as widely distributed in tropical America and the West Indies, and extending into the eastern United States. But the North American species, *S. glabra* Michx. is distinct from the tropical species, which is *S. riparia* Cham. & Schl.

(2) The reference to Royen gives no help, as he merely cites the plate of Dillenius, which includes also a second species which is *Spermacoce verticillata* L., now placed in *Borreria*.

(3) Plukenet's figure has been generally regarded, for instance by Gray (Synopt. Flor. N. America), K. Schumann (in Martius, Flor. Brasil.) as representing the plant generally known as *Spermacoce tenuior* L., the type, in fact, of that species. There are two specimens referred to the figure in Plukenet's herbarium, which is included in Herb. Sloane at the British Museum: both represent *Borreria laevis* (Lam.) Griseb. (*S. laevis* Lam.).

Linnaeus's brief description 'glabra, staminibus inclusis' fits *Spermacoce riparia*, but excludes *Borreria laevis*, in which the stamens are exserted. The name *Spermacoce tenuior* must therefore be applied to *Spermacoce riparia* Cham.

& Schl., and the next valid name must be adopted for *S. tenuior* of authors; this would appear to be *S. remota* Lam. Gaertner (Fruct. 122, t. 25, f. 9) gives a good figure of the fruit of *S. tenuior* auct., which was copied by Lamarek (Tabl. Encyc. Bot. i. 273, t. 62, f. 1) and the species has been cited as *S. tenuior* Gaertn. and *S. tenuior* Lam.

Mr. J. RAMSBOTTOM said that he had followed Dr. Rendle's investigation with great interest. It was always fascinating to trace out the ideas of the older botanists and to discover whether what they regarded as synonyms were really such. In the present instance we again had an indication of the value of the pre-Linnean herbaria in bringing precision to the interpretation of Linnean names.

Monilia sitophila in England. By Mr. J. RAMSBOTTOM, O.B.E., Sec.L.S., and Miss F. L. STEPHENS, M.Sc.

THE fungus *Monilia sitophila* (Mont.) Sacc. was first recorded as a pest of French Army bakeries in 1842. It has since been found on various substrata both on the continent and in America, but the only published records in this country are two after mill-fires and one on burnt trees. The fungus, however, has been recorded under other names and is the fairly common *Oidium Lupuli* occurring on spent hops.

Shear and Dodge (1927) found that the species was a composite one and that it formed the conidial stages of a Pyrenomycete which they named *Neurospora*.

Two species of *Neurospora*, *N. tetrasperma* and *N. sitophila*, have been found in this country, the former at Woolwich on burnt gorse—it was first described from Surinam—and the latter by Mr. W. H. Wilkins on the ends of kilned beech at Chichester.

N. tetrasperma has four spores in the ascus and is homothallic; *N. sitophila* has eight spores and is heterothallic.

As Shear and Dodge found, occasional small ascospores occur in *N. tetrasperma*, and these, when grown, give rise to heterothallic strains. Further work by Dodge (1927) showed that these small spores are uninucleate like those of *N. sitophila*, but that the normal spores are binucleate. Thus it appears that in this genus homothallism and heterothallism are related to the nuclear condition of the spores.

All strains show archicarps. In unmated heterothallic strains the archicarps do not develop beyond a stage which resembles a sclerotium. Cultures and photographs were shown of the species and crosses illustrating the phenomena described.

The PRESIDENT asked whether the fungus described was supposed to be a recent importation.

Professor F. E. WEISS thought that an important advance had been made in proving that the uninucleate ascospores produced heterothallic and the binucleate ascospores homothallic mycelia. He would like to know whether the sterile sclerotia formed on the heterothallic mycelia might be regarded as organs of vegetative reproduction intended to last out during periods adverse to the growth of the mycelium.

Mr. Ramsbottom, in reply, said that it was uncertain at present whether *Neurospora tetrasperma* was a new arrival or not—although it had been a surprise to find it. He was inclined to look upon the sclerotium as representing an incomplete structure rather than as an adaptation.

The following paper was read in title :—

‘Alpine Desmids from British Columbia.’ By NELLIE CARTER, D.Sc., F.L.S.

22 November 1934

Dr. W. T. CALMAN, F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 8 November 1934, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Cecil Thomas Prime ; for the first time, in favour of Bertram Lloyd, Ronald Winckworth, Charles Edward Hubbard, Herold Georg Schweickert and Charles Hervey Grey.

The President reported the death of George Chapman Walton, F.L.S.

Walter Moyle's list of Cornish birds (1715–17) entered in his copy of Willughby's 'Ornithology'. By Dr. R. T. GUNTHER. DR. GUNTHER exhibited a copy of Willughby's 'Ornithology', 1678, with marginal notes, which he believed to be the long lost volume in the margins of which Walter Moyle entered observations on the birds in his collection. At least 129 species of birds are noted, usually with a record of their local names, their weight when killed, and of the date when they were sent to the bird-stuffer for being put up in cases. The record covers the years 1715–17 and is the most complete list of Cornish birds known at the time.

Walter Moyle (1672–1721) was the son of Sir Walter Moyle of Bake near Loo, M.P. for Cornwall in 1654–5. Both father and son were at Exeter College, Oxford. His interests in natural history were undoubtedly stimulated by the work of John Ray, and were at first wholly botanical, but before 1716 he appears from letters to Sherard to have specialized on forming a collection of the birds of his county, and with conspicuous success.

Three of these letters on birds have been printed in J. E. Harting's edition of Rodd's 'Birds of Cornwall', 1880, but his marginal notes have apparently remained unknown until the present year. The collection was destroyed by a fire.

A few of the birds, including a specimen of a Great Auk 'from Newfoundland', came from overseas.

Mr. WALTER S. ROWNTREE remarked that in a sister volume which was in his possession—Willughby's 'Ichthyographica' (published in 1686)—there are similar marginal notes, written by some ancient hand, but more quaint than scientific. He also referred to the series of very fine plates in that work, each of which bears the name of one of the original Fellows of the Royal Society—Pepys, Boyle, Newton, Ashmole, and many others—who had made themselves responsible for the expense of the individual plates.

The hope was expressed that the notes would be published.

A contribution to the Moss Flora of Borneo.

By Mr. H. N. DIXON.

THE paper is based mostly on two recent collections, one by R. E. Holttum on Kinabalu, the other by the Oxford University Expedition to Sarawak, on and about Mt. Dulit. The richness and interest of the moss-flora is evidenced by the description of two new genera and 72 new species, as well as over 80 new records for the island.

Interesting features of geographical distribution are the occurrence of several palaeartic genera and species on the summit of Kinabalu, including a new species of *Andreaea*, the most southerly in Asia; also a new species of *Leptodontiopsis*, a genus hitherto known only from two tropical African species.

Reference was made to a confusion arising in terminology, the term 'symmetrical' as usually employed in botanical works being different from the German term 'symmetrisch', which denotes bi-lateral symmetry.

Specimens of Borneo mosses were exhibited, to illustrate methods of mounting.

The PRESIDENT suggested that the term symmetrical as applied to moss capsules and flowers was incorrect; the

proper term would be radially symmetrical, while bilateral symmetry would correspond to the German 'symmetrisch'.

Mr. P. W. RICHARDS said that the greater part of his collection had been made in the neighbourhood of Mt. Dulit, a sandstone ridge about 4,000 to 4,500 feet high, situated about sixty miles from the coast of northern Sarawak. The greater part of the district was covered with primary forest, of which three types were recognized, in the lowlands Mixed (Dipterocarp) forest on clay soils and Heath forest on sand, and on the mountain above about 3,500 feet. The two former were types of tropical rain-forest and lived under a typically equatorial climate, the last lived under considerably cooler and more constantly moist conditions. Some of the chief features of the moss vegetation in each type of forest were referred to. A particularly striking feature of the Mixed forest was the almost complete absence of mosses on the ground, which is perhaps due partly to the carpet of dead leaves and partly to the low light intensity.

Mr. I. H. BURKILL stated that he had been in forests where mosses grew on exposed knuckles of tree-roots, but not on the bare soil between them; and that he considered the absence of the mosses from the soil as due to the blanketing effect of fallen leathery leaves hammered down by heavy drops of water.

Mr. DIXON agreed with the President's remarks.

**The British Museum (Natural History) Expedition to the
Birunga Volcanoes, 1933-4.** By Mr. R. AKROYD (Visitor).

IN May of last year I went to S.W. Uganda to collect the material required for the case of gorillas in their natural surroundings which is being set up in the Museum. I arrived at Kampala on 19 November, and after more than a month occupied in organising the expedition I started on 28 November with forty-two porters. The first march was a short one to Lake Bunyoni, which is two hundred feet above Kabale. We crossed the Lake in dugouts, and on arrival at Bufundi Rest House I found Captain and Mrs. Pitman, who were returning from a tour in the gorilla country. They kindly gave me some valuable information about the conditions there. I left Bufundi Rest Camp on 30 November and arrived at Behungi Rest Camp (8,214 ft.) after three and a half hours' march, an ascent of two thousand feet. Here I had a good view of the volcanoes, with the lava plain down below, and on the following day descended to Nyakabande and continued to Gisoro and Mabungo Rest Camp (6,800 ft.), a march of four hours. Mabungo is a useful base for collecting, and is within easy reach of the volcanoes, Mt. Sabinio, the farthest, being only four and a half hours' march. The Birunga or Bufumbiro

Mountains are a chain of volcanoes running from east to west, the northern slopes of the first three, Muhavura, Mgahinga, and Sabinio, being in Uganda, as the Belgian boundary-line runs over their summits. The remainder of the chain are in Belgian Territory. There are two active volcanoes in the chain whose glow can be seen on a cloudy night. The slopes of these volcanoes are covered with dense bamboo forest which gives way at a certain altitude to the alpine zone, where the gorilla are to be found. Though abundant and more or less localized in the Belgian Congo over the border, the gorillas here are mostly migratory, probably because they are frequently disturbed by the natives cutting bamboo for charcoal and because the rainfall is less on the northern slopes than on the southern and the vegetation therefore less luxuriant.

My first expedition was on 4 December to Mt. Mgahinga, the middle of the three volcanoes. A gradual ascent from the plain, not difficult, brought us up to the saddle between Muhavura and Mgahinga, where I pitched my first high camp at 10,000 feet. The weather was very cold with heavy rain often lasting more than two hours. I had as guides three Batwa, half pigmies. These people live on the slopes of the mountains in the bamboo forests and are good hunters; they know the habits of the gorilla, and one of them used to keep the whole camp amused by his imitations of the animal. The following day I made my first ascent to the crater. For the first thousand feet we had to cut our way through dense bamboo until we reached the heather zone, where travelling becomes easier. We reached the top in four and a half hours. On my way up I saw a gorilla's nest of recent occupation with wild violets growing in a bank close by. The gorilla's nest is built on the ground with intertwining of small branches and twigs, &c., the big male having his nest in the centre and the family grouped around him. They generally choose a sheltered place, under the roots of an old tree or under a bank. They are said to pass one or two nights in one place, and then move on, leaving their nest fouled. They often return later to the same spot and build another nest on top of the old one. The giant Lobelias, Senecios, and giant heather grow over twenty-five feet high. It was here my work lay. The composition of the working party I usually took out was as follows:—Three Batwa; then myself with rifle, followed by two men carrying camera; then eight porters carrying gunny bags (in which to put the specimens), and an axe, saw, and pangas. The time spent in the high camp was three or four days; it depended on the weather, as the bulk of the material I had to collect dried more easily at the Rest Camp, where there was more sun. The giant

Lobelias gave me most anxiety, as being very succulent they had to be split in two. The following method was used which dried them in ten days : they were placed on a sheet of corrugated iron, held up by wooden struts ; a long trench was made underneath, a fire lit and sacks were placed over the Lobelias. Great care had to be taken that the heat of the fire was not too great. Amongst the other things I had to collect were numbered sections of large and small trees and their bark, also moss and ferns of which there was a great variety.

After Christmas I made a final expedition to the volcanoes to finish up, and on 5 January 1934 I started off for the Kayonza Forest, three days' march north of Mabungo, crossing Lake Mutanda for the purpose of collecting tree-ferns and a section of a very large tree. The area of this forest is approximately one hundred and fifty square miles, and there are only two regular trails through it, one of which, if not used frequently, has to be kept cut. This area, which is not well known, contains a collection of impenetrable hill forests, some of which reach 7,900 feet. Gorillas are found here, but their number is uncertain. They live under different conditions from those on the volcanoes, building their nests in the trees about ten to twenty feet from the ground. They are probably a different race, perhaps allied to those in the Ituri Forest. It was here that I got my only glimpse of a gorilla family. Camped high up in a valley west of the Kashasha River I saw them early one morning a long way off across the valley on a slope partly covered with fern. Spending two and a half hours cutting our way up the hill through the dense foliage and the tunnels made by the gorilla we arrived within a few yards of them, but on hearing our approach they made off. I found lumps of white stuff, quite warm, on the ground which they had just left—no doubt they had ejected what they had been chewing before they went off. I returned to Kabale to spend three days in packing up my collection and then left for Kampala, where I arrived on 26 January.

Captain J. G. DOLLMAN remarked that Mr. Akroyd's expedition to the Birunga Mountains and Kayonza Forest was undertaken solely for the purpose of procuring the necessary vegetation required for setting up the group of Eastern Gorillas in the British Museum. The difficulties in the way of the preservation of the material were very considerable ; so much so that a former expedition failed entirely in its purpose. He thought Mr. Akroyd was to be congratulated on the excellent condition in which the majority of the specimens arrived at the Museum.

Until fairly recently the Birunga district was an almost unknown territory. One of the first Englishmen to visit the mountains was the late Mr. T. A. Barns, who went there to collect gorillas for the British Museum and other institutions. In this he was successful, but we still remained in ignorance of the type of country in which the giant ape made its home. It was not until Mr. Marius Maxwell visited the district with his camera that we had any idea of the scenic surroundings of the eastern gorilla. Like Mr. Barns he approached the mountains from the Belgian Congo side, doing most of his photography on Mount Mikenno and Mount Karisimbi. He found, like all other photographers who visit this district, great obstacles in the way of success. Firstly, the vegetation is so dense that it is almost impossible to see the gorillas, the ground vegetation in most parts being about six feet in height. Further, it is always raining in these equatorial forests—in fact, the climate would appear to be much the same as we used to associate with the British summer climate.

After Mr. Maxwell's visit there was a Swedish expedition which went to hunt the gorilla, and some years after that Lord Howard de Walden and Mr. Marcuswell Maxwell visited the Birunga Mountains with the idea of taking photographs of the gorillas in their surroundings. While on the mountains Lord Howard de Walden made some water-colour sketches of the scenery, which would be of very considerable value to the artist in preparing the background of the gorilla group. More recently some excellent photographic material of the Kivu forests has been obtained by Lady Broughton and Colonel Ashton and has been placed at the disposal of the Museum authorities.

Mr. Akroyd approached the Birunga Mountains from the Uganda side, not from the Belgian Congo. He concentrated upon collecting vegetation on Mts. Mgahinga, Muhavura, and Sabinio, and did not visit the Belgian mountains of Karisimbi, Mikenno, and Visoke. Among the vegetation which he brought back was a quantity of Giant Lobelias, and a large supply of the 'beard-moss', which growth shrouds every bush and tree in the gorilla forest.

Captain Dollman also remarked that the Museum, in addition to receiving the photographs, sketches, and vegetation already referred to, had received a donation from the Marquis Hachisuka which consisted of two sleeping platforms of the gorilla from the Birunga district. He preferred the term 'sleeping platform' to 'nest', as there was less likelihood of being asked how many eggs the gorilla lays. One of these sleeping platforms would be used in the construction of the group which Mr. Akroyd's expedition had done so much to further.

Professor HALE CARPENTER said that as he was possibly



John Bea Sons & Danvers Ltd. London

FEMALE ASIATIC ELEPHANT, AGED 43 YEARS, WITH FIVE OF HER CALVES
BORN IN 1908, 1915, 1921, 1926 AND 1931.



the only Fellow present who had set foot in the country described by Mr. Akroyd he wished to express his appreciation of the photographs, which showed very clearly the character of the western Rift Valley.

Few who had seen the floor of the valley from the top of the eastern escarpment could forget their first impressions of the panorama shown in Mr. Akroyd's pictures, which gave so good an idea of the bare lava with its assortment of volcanoes of all sizes, from that of a small house to the giant Muhavurra, and the cultivated patches of soil among the loose blocks of lava carefully gathered together in piles by the natives.

In connexion with the pictures of Lake Bunyoni he alluded to the large numbers of frogs which live in the deep waters and must have been the chief food of the abundant otters. After the war the District Commissioner, finding that a small Silurid fish which abounded in neighbouring streams had apparently never found its way into the drowned valley which now forms the lake, introduced some. They flourished exceedingly and, spitted on sticks and sun-dried, form an important article of food. So much relished are they by distant tribes that a man will make the journey of several hundred miles to obtain a load and carry it back to the populous centres on the north coast of Lake Victoria. The name of the fish is given as *Clarias carsonii* by Dr. E. B. Worthington ('Inland waters of Africa').

Dr. A. B. RENDLE commented on the luxuriousness of the montane vegetation as shown in the excellent photographs, and expressed the hope that Mr. Akroyd had brought back a good supply of specimens for study.

The PRESIDENT, in thanking Mr. Akroyd, expressed to him the indebtedness of the British Museum for the collections he had obtained.

Three zoological exhibits.

By Capt. J. GUY DOLLMAN.

CAPTAIN DOLLMAN exhibited a photograph (Plate 1) recently presented to the British Museum by Mr. Gordon Hundley and made the following remarks:—

This photograph was taken in the Thoungyin Forest in 1934, and represents a female Siamese elephant with five of her offspring. There should have been six, but it was impossible to get them all on parade at the same time. The youngest elephant, a calf standing about 4 feet 6 inches at the shoulder, is about three to three and a half years old. The next calf was born in 1926, and the one in the middle in 1921. The next one, with the tusks, was born in 1915. Then there is

the gap where the missing elephant should come, and then comes the oldest member of the family, on the left, born in 1908. The mother's age is given as forty-three years, so that she began to breed when only about fifteen years old.

Available figures as regards the breeding age of elephants are largely taken from menagerie collections. Information from elephant breeding centres in Asia tends to show that the females can breed as early as thirteen years of age, a case on record being a female fifteen years old which produced a calf.

Captain Dollman exhibited a rare Flying Squirrel and made the following remarks concerning it:—

The Museum has recently received as a donation from Miss A. E. Thomson a mounted specimen of a small Flying Squirrel (*Sciuropterus everetti*) from Borneo. This is a very rare species and we have never had a mounted specimen of it before. We have in the Museum the type and three skins of this form, so that this new specimen now brings our series up to five. The species *everetti* was made the type of a subgenus by the late Oldfield Thomas which he called *Hylopetes*, a subgeneric group which included about half a dozen species of small flying squirrel distributed between Nepal and the Malay Islands. How far this arrangement is satisfactory I am not at the moment prepared to state, but it would seem that the small flying squirrels of Asia undoubtedly fall into various groups, which can be distinguished by dental characters and the size of the orbital bullae.

Captain Dollman further exhibited the skull of a so-called dwarf elephant, or 'sumbi', from the Gola Forest, Sierra Leone, presented to the Natural History Museum by Sir Arnold Hodson, K.C.M.G., the Governor of the Gold Coast. Captain Dollman remarked that this specimen was quite a young one, as was evident from examination of the teeth—the last milk teeth, or first true molars, being still in position. Further, the open sutures of the skull showed the animal to be quite a young individual, probably not more than five or six years old and possibly considerably less.

It was a matter for comment that the native hunter who secured this specimen should have told Sir Arnold Hodson that it was an adult individual. Such a remark, coming from an experienced hunter, appeared to be inexplicable, and one was forced to the conclusion that the natives of the Gola Forest regarded all young elephants as representing a dwarf species of elephant. To the systematic zoologist, however, surrounded by such a wealth of material as was now available, thanks to the efforts of Sir Arnold Hodson and Major P. H. G. Powell-Cotton, there was but one solution, and that was

to regard this Gola Forest elephant as representing a young specimen of the small Forest Elephant, for which the name *Loxodonta africanus cyclotis* was available.

Captain Dollman also drew attention to a remark by the native hunter to the effect that he (the hunter) did not know where elephants went to die, a remark which seemed to suggest a belief in the far-fetched theory of elephants' cemeteries. It was certainly an acknowledged fact that elephants of advanced old age segregate themselves and remain quite apart from the herd, preferring some secluded spot in which to pass the end of their days. It was also a well-known fact that a wounded elephant preferred to seek its end in the denser and more impenetrable parts of the bush. Such isolated cases as these, however, did not constitute an elephants' cemetery, and the occurrence of the accumulation of elephants' remains would appear to be due to one of three causes. Firstly, a number of skeletons are sometimes found together where a herd of elephants has been ruthlessly shot down or speared by ivory hunters. Secondly, a number of skeletons collected together might be evidence of the animals having been bogged and unable to extricate themselves. Thirdly, there was the possibility of a party of elephants having eaten some poisonous soil or vegetation or drunk some poisonous fluid.

A quantitative study of geotropism and of the development of the statolith apparatus throughout the life history of the Wheat Plant. By Miss F. M. O. WAIGHT (Visitor).

THE reaction to gravity of the wheat plant has been measured throughout its life-history, and may be represented by a *Graviscrypt* (Pranker, Journ. Linn. Soc., Bot., 1929). Gravi-perceptive power varies greatly at different stages; at the seedling stage it is more than ten times, and at the flowering stage more than twice its value at the leafy stage.

Cytological examination shows that the production of statocyte tissue corresponds not only in time and position, but also in amount with the varying intensity of gravi-perception.

The physiological zygomorphy (Brain, Ann. Bot. 1926) exhibited by the hypocotyls of certain Dicotyledons is shown to hold good for the coleoptile of the wheat seedling; both the coleoptile and the swollen leaf-bases are regarded as definite sense organs for the perception of gravity.

Dr. PRANKERD explained that according to the theory of 'statolith efficiency' the quicker reaction was due to the arrangement and symmetry of the statocytes, whereby a

greater amount of sensitive protoplasm is stimulated in a shorter time in the intervascular plane of the seedling wheat plant. The ratio can be calculated and agrees almost exactly with that found experimentally.

She considered that Miss Waight's work by establishing a correlation between the life-history and the development of both gravitational irritability and the statolith apparatus had afforded fresh support for the statolith theory of geotropism. She remarked on the slowness of botanists to accept what seemed to form no stumbling block to zoologists.

Miss E. D. BRAIN said how interested she had been in Miss Waight's paper. She recalled that in her own work on three different species of Lupin, she found the shortest presentation times occurred in the inflorescence stage in two species. In the third species, the tree Lupin, no decrease in the presentation time was found.

Professor F. E. WEISS expressed his interest in Miss Waight's communication. It was the first time, as far as he knew, that the sensitiveness to gravity of a plant had been recorded at every stage of its development. Dr. Prankerd had spoken of the wheat plant as being at the stage when the older starch statocytes were being replaced by oxalate crystals for the perception of gravity. Did the seedling stages possess the former, and might one regard the seedling as showing the more ancestral method of graviperception?

In reply, Miss WRIGHT agreed that the starch statocyte was probably primitive, and the crystal statocyte a later evolutionary development.

6 December 1934

Dr. W. T. CALMAN, F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 22 November 1934, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time, in favour of Bertram Lloyd, Ronald Winckworth, Charles Edward Hubbard, Herold Georg Schweickert and Charles Hervey Grey, D.S.O.; for the first time, in favour of Reginald Akroyd and Humphrey Robert Hewer.

The following candidates were balloted for and elected Fellows :—Ram Surat Singh, B.Sc., Geoffrey John Kerrich, Francis Hemming, C.B.E., William Thomas Stearn, George Osborne King Sainsbury, Comyns John Augustus Berkeley, B.Sc., Edmund Frederic Warburg, John Hemsworth Osborne Day, B.Sc., Ph.D., Salvatore Louis Vella, B.Sc., Ph.C., M.D., Arthur Knyvett Totton, M.C., George Eric Howard Foxon, M.A., and Cecil Thomas Prime, B.A.

The Percy Sladen Zoological Expedition to the British Cameroons, 1932–33. By Mr. IVAN T. SANDERSON.

AN expedition to the British Cameroons was undertaken during the period August 1932 to August 1933 for the purpose of collecting zoological specimens of certain groups, and also studying their habits and ecological distribution in the field. The Expedition bore the name of the Percy Sladen Memorial Fund, in recognition of that body's assistance in raising the necessary funds.

The results of the trip—which was itself singularly lacking in the customary misfortunes—were a very large collection of valuable material, including 1500 Mammals, 1200 Reptiles and Amphibians, and several thousand invertebrates made up of Molluscs, Arachnida, Crustacea, Parasitic Insects and Worms, and Myriapoda. In addition, several hundred photographs and detailed drawings, augmented by a great bulk of data, were recorded from those specimens, as well as subsidiary collections of special organs for embryological and anatomical research.

The exact localities chosen for investigation were situated about the drainage basin of the Cross or Old Calabar River, in what is now termed politically Southern Nigeria. In its upper reaches, this river enters the Mandated territory of the British Cameroons, but throughout its length traverses the High Forest Zone. Apart from the last month in the field, all the work was carried out in the Mamfe Division of the Cameroons, which is an area clearly defined by natural boundaries. A ring of grass-covered mountains encircles the drainage basin formed by the headwaters of the Cross River, and is only broken in the north-west by a narrow valley, through which this river finds an exit. This basin is clothed in high deciduous forest, which is almost exclusively virgin growth throughout its northern half, while in the extreme north the Mountains of Assumbo are practically unexplored and uncharted.

The animals collected include such a wide range of forms that a systematically arranged account is probably preferable.

Issued 10 May 1935]

d

Commencing the Mammals with the Primates, brief mention should first be made of the indigenous human population. These are semi-bantu Negros for the most part, though some partially Aryanized tribes from the north and pure Bantu-speaking peoples from the south were met with. Also, traces of aboriginal Bushman ancestry could be seen among the forest tribes. The Apes are represented by a Gorilla (*G. g. maatschii*) from the mountains of Assumbo and the Pink-faced Chimpanzee (*Pan satyrus*) which abounds in the dense virgin forest towards the east of the district. The Gorillas, of which the expedition obtained a large male, a very young female, and several skulls, are numerous in the Mountain Moss Forest belt, where the natives record their movements minutely, by reason of their family likenesses and great inter-family variations. This is an entirely neglected point in Gorilla controversies, and one to which attention should be paid.

In the forest country the Drill (*Cynocephalus leucophaeus*) abounds, while there is a Baboon on the northern slopes of the Asumbo mountains which was not obtained. The Drill, however, takes its place throughout most of the open grass country, which is rather exceptional. Ten species of Monkey were obtained, including one *Colobus*, one *Cercocebus*, and the Patas (*Erythrocebus*), which latter is exceedingly common in the high mountain grass, where it roams about in parties, running like dogs, and appears to be entirely terrestrial. The commonest Cercopithecoid was the Mona, of which a very beautiful green and yellow variety (*C. mona wolfei*) was taken in the foot-hills.

The Lemurs were represented by the Potto (*Perodicticus*), the tail-less Angwantibo (*Arctocebus aureus*), and three long-tailed forms, *Euoticus elegantulus*, *Galago alleni*, and *G. demidovii*. *Arctocebus*, which is apparently represented in the National Collections only by one damaged example, was quite common, and we had on one occasion as many as six alive about our camp. *Galago alleni* has developed a peculiar race near Nko on the lower Cross River, in which the tail has become white, a specific character of this species being the black tail.

More than twenty-five species of Bats were collected, among them the Hammer-headed Fruit-Bat (*Hipposignathus monstrosus*) and several unknown species of Microchiroptera. Shrews of several species formed the bulk of the Insectivorous fauna, but in addition a series of the rare *Potamogale velox* was caught. These Giant Water Shrews inhabited the mountain streams of Asumbo, where they live upon Crabs and had to be chased with native torches at night, being too wily for traps or guns.

The country supports a vast Rodent population. In giant hollow trees, Flying Squirrels (*Anomalurus*) and the Flying Mouse (*Idiurus*) were to be found in company with several species of arboreal Dormouse. In the high forest were innumerable Squirrels, many of which were ground-living forms, as well as the Porcupine (*Atherura*), which latter frequents Termites' nests and is hunted in Bamenda much as the Fox is in our own country. Rats—numbering more than fifty species—are found everywhere. In the primary forest, eight constant species prevail, none of which is met with in country which has once been cleared. In this secondary growth, thirty-two entirely different species have taken up their abode, many of them types that are indigenous to the grass-lands of the north. In the grass of Asumbo were twenty-one species, fourteen of which were again distinct.

Leopards are exceedingly common in the forest, and a light-coloured variety is met with on the highlands bordering the more open country. The rare *Profelis aurata* or Golden Cat, which grows to the size of a small Leopard, is common in Mamfe Division. A native ju-ju prevents the procuring of skulls, but skins may be seen in every village. Genets and False Palm Civets (*Nandinia*) literally swarmed in the trees, and several species of Mongoose were to be found. The latter mostly fed upon the crabs which abound in every habitat. Along the lower reaches of the Cross River, a long-haired variety of the Serval (*Leptailurus serval*) has taken to inhabiting the forests, where it quite displaces the Civet, which is common elsewhere.

Although Elephant, Hippopotamus, several large Buck, Buffalo, and Bush-pig are known to be common in this locality, we were not in need of specimens. Much time was, however, spent in procuring a series of the Water Chevrotain (*Dorcatherium aquaticum*) which proved unexpectedly common, and certain other smaller Ungulates, among them a species of *Hyrax* which the natives capture alive.

At Ekuri in Southern Nigeria a young male and a young female Manatee were harpooned by the natives after having been enticed into a trap prepared for them and baited with the leaves of the Coco-yam. Their skeletons were preserved, though the species is well known. The remaining Mammals found were two species of Pangolin, *Manis tricuspis* and *Uromanus longicauda*.

The second group of animals which formed as great a proportion of our collection as the Mammals, was the Reptiles and Amphibians. These, being comparatively neglected groups, do not possess such a high proportion of recognizable names. Mention may, therefore, be made only of species that are of particular interest.

The ninety-two snakes collected have proved to contain 45 species, which seems to be a very large number for so small an area. The remaining reptiles were five well-known Chameleons and several lizards, one of which (*Lygosoma*), a skink inhabiting open sandy ground, was found to be the originator of a ghostly whistle that can be heard for over a mile. Among the Amphibians are large series of the Hairy Frog (*Trichobatrachus*), the Giant Frog (*Rana robusta*), and several little-known types, besides a new species of Coecilian, of which the life-history was unravelled in considerable detail in the field.

The Invertebrate groups have not yet been named, but again certain outstanding species were collected. New Opilionids and Spiders were taken in the forests, and also a collection of five hundred Podogonids, twenty of which were brought back alive. The latter group were previously represented only by a handful of specimens scattered throughout the Museums of the world. Several of the Parasitic Worms taken from Mammalian hosts prove to be highly valuable, and the terrestrial Mollusca form a selection from a locality which has not previously been investigated.

Dr. W. RUSHTON PARKER asked what the creatures were which the Carthaginian Hanno found on the West African coast in the Fifth century B.C., which he took to be hairy men and women, called by the natives Gorillas, which defended themselves by throwing stones, and of which some females were killed and their skins shown for centuries in Carthage, and often now said to have been baboons.

Mr. M. A. C. HINTON congratulated Mr. Sanderson on the splendid character of the collections which he had made in an area from which material had long been desired. It would take a very long time to arrive at the full results of the expedition, but it was of the utmost importance to obtain full collections from virgin country in the continent of Africa where the face of Nature was being changed with great rapidity by white civilization.

Dr. J. M. DALZIEL asked whether amongst the numerous rodents collected by the Expedition a certain little-known rat (*Otomys burtoni*) was represented. This occurs on Cameroons Mt. in the grasslands above the forest. Cameroons Mt. proper is a different mountain system from those surrounding the Mamfe Basin; it is more than twice as high, geographically separate, and of different geological structure. The fauna of the former has therefore probably many endemics not so far found on the other mountains of Cameroons. The rat in question must have been abundant at the time of the earliest climbers. When Richard Burton and Gustav Mann

and party in 1861-62 spent some time at Mann's Spring (7,000 ft.), they amused themselves by trapping this animal, which makes long tunnels with a double entrance and throws up a heap of earth, its occurrence being noted almost to the summit. Yet it is very sparsely represented in museums either in this country or in Germany. The Germans seem to have named the same animal *Euryotis irrorata*, and it would be interesting to know whether this mountain rat has a wider distribution.

Mr. SANDERSON, in a brief reply, said that he had not come across the rat mentioned by Dr. Dalziel.

The South Orkney Islands. By Mr. D. DILWYN JOHN.

THE main work of the Discovery Committee's vessels is oceanographical research in Antarctic waters, and it has been for the most part in the Falkland Sector of the Antarctic. When time can be spared it is used for surveying the badly charted coasts of the Dependencies of the Falkland Islands. During the second commission of the R.R.S. *Discovery II.*, October 1931 to May 1933, the month of January 1933 was occupied in making a survey of the South Orkney Islands.

The group lies between the latitudes of 61° and 62° S. in approx. 45° W. and is composed of four larger islands, the largest about thirty miles long by twelve broad, and many smaller islands and rocks. It is truly Antarctic in character, the larger islands being covered with a permanent snow and ice cap. They rise to a height of between 3,000 and 4,000 feet and are, in places, broken and rugged, and parts of their coasts are high and steep. Much of the glaciation is of Highland Ice, a thin covering showing the shape of the underlying land; the valleys are occupied by glaciers, but none of them is big. Where the land is lowest the coasts are made up of long unbroken stretches of ice-cliff; where it is highest it falls in tremendous cliffs to the sea, the steepest free of ice and snow, the more broken parts ice-encrusted or carrying hanging glaciers and ice-falls fed from the cap above, which in their turn feed fringing ice-foot glaciers at sea-level below.

Every winter the islands are surrounded by pack-ice continuous with that covering the Weddell Sea, while in summer they are free of ice; the periods are very variable and streams of pack-ice may be brought upon their coasts even in mid-summer. They lie directly across the path of the Weddell Sea Current and stranded ice-bergs of all sizes are very numerous along the southern coasts; there were about 1,500 in January 1933.

The group was discovered and taken possession of in 1821 by the British sealer George Powell, who had sailed east

from the neighbouring South Shetland Islands, discovered only two years before, in search of fur-seal. He, and James Weddell who came later that same season and again the following year, and Dumont D'Urville who sailed along the northern coasts in 1838, each made surveys of parts or of the whole of the group. A chart based on the sum of their work remained the only one until early in this century, when the Scottish Expedition under Bruce in the *Scotia* wintered in Laurie Island, the easternmost, in 1903 and made a triangulated survey of it. Even so, the Admiralty chart corrected to include their work remained very small and cautioned navigators that the charting of the group was 'only approximate'.

The survey of the *Discovery II* was based on four positions fixed on the land by solar observations; the coast-lines were determined by the method of running survey; detailed plans of the harbours were made by landing and boating parties; numerous inshore soundings were taken with the echo-sounding machines. A new and large-scale Admiralty chart, with plans of the harbours as insets, will shortly be published.

Large collections of the rocks and of the plant and animal life were made at seven widely separated points in the islands. The rocks are being examined and will shortly be reported upon: it will be of the greatest interest to know if they show an affinity with those of Graham Land and Tierra del Fuego, which are related. It is believed by most geologists that they were once connected by a great eastwardly directed mountain loop, of which South Georgia, the South Sandwich and South Orkney Islands are unsubmerged remnants. The numerous soundings of the *Discovery II* show that a submarine ridge connects them all.

The flora of the islands is poor in species, poorer than might be expected from their latitude. The predominant forms are lichens and mosses, but there are fewer species of both than in Graham Land farther west and south: fourteen mosses and eleven lichens are known from the South Orkneys, whereas twenty-seven mosses and fifty-five lichens have been found on the west coast of Graham Land, as well as two flowering plants and three hepatics unknown from the South Orkneys. There are, nevertheless, pleasing patches of vegetation in the lower snow-free places.

Seals and sea birds are summer visitors that leave when the islands are ice-bound in winter. Fur-seals once occurred in small numbers, but none remains; there are Sea Elephants, Weddell Seals, Sea Leopards, and occasional Crab-eaters. Eighteen species of birds nest in the group, some in enormous numbers; there are Petrels, Gulls, Terns, a Shag, the Sheath-bill, and Penguins. Adélie and Antarctic Penguins are very

numerous. There are few invertebrates: two earthworms, some free-living Nematodes, three Collembolans, and a few mites are known.

The islands were used as a base by the Norwegian whalers for a period before the war and for another after, until the coming of pelagic whaling. A meteorological and magnetic station, founded by Bruce on Laurie Island, is maintained by the Argentine Government to the present day.

A full account of the islands by Mr. J. W. S. Marr will shortly be published in the Discovery Reports.

Dr. F. D. OMMANNEY: There is little that I can say except to congratulate Mr. John on his excellent description of these charming islands. The beautiful photographs which he has just shown were taken on the few days when we had brilliant weather, without the usual snow or fog. On these days we were able to make boating expeditions about the bays and harbours, and to make valuable collections of rocks and lichens, which we hope will soon be worked out. We look forward to the appearance of Mr. Marr's report on the islands.

Dr. E. J. COLLINS asked what were the two higher plants, found growing on Graham's Land, which had been unable to establish a footing on the South Orkney Islands.

Mr. C. V. B. MARQUAND and Dr. STANLEY KEMP also spoke.

Mr. JOHN, in replying to Dr. Collins, stated that the two higher plants found on Graham's Land were *Deschampsia antarctica* and *Colobanthus crassifolius* var. *brevifolius*.

10 January 1935

Dr. W. T. CALMAN, F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 6 December 1934, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted:—Cecil Thomas Prime, Edmund Fredric Warburg, Edward Hubert Chater, Dorothy Bexon and Salvatore Louis Vella.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time, in favour of Reginald Akroyd and Humphrey Robert Hewer; for the

first time, in favour of Ivan Terence Sanderson, Douglas Stewart Raitt and Richard Holliday Pott.

The President reported the deaths of Dr. Nicholas E. Brown, Associate, and of the Rev. P. G. M. Rhodes, D.D., Fellow, of the Society.

Zoological notes from the voyage of Peter Mundy, 1655-56.

(a) **Birds.** By Mr. N. B. KINNEAR; (b) **Sea Elephant on St. Helena; Whale at Greenwich.** By Mr. F. C. FRASER.

PETER MUNDY was a Cornishman and was born at Penryn about 1596, and, after making several journeys in Europe to various places including Constantinople, he joined the East India Company and sailed for India in 1628, returning in 1634. In the following year he accompanied Sir William Courten's fleet to India and Japan returning in 1638. After a year in England he went to Russia, Prussia and Poland, and was absent for seven years. Then in 1655 he sailed on his third voyage to India in the *Aleppo Merchant* and came back in 1656.

Mundy was a very careful observer and made many interesting notes in his journals, frequently illustrating them with sketches*. In the three volumes of his travels, which have already been published by the Hakluyt Society, various animals are mentioned and some of his sketches are produced, including that of the extinct Rail—the Mauritius henne of Mundy, *Aphanapteryx bonesia* (vide 'Journals of Peter Mundy', vol. iii (pt. 11), p. xvii, and Selater, 'Ibis', 1915, pp. 316-319). The fourth and final volume is being edited by Miss Anstey, who assisted the late Sir Richard Temple with the earlier volumes, and, through the kindness of the president and council of the Hakluyt Society, we are enabled to reproduce some notes and drawings of Mundy's for this volume. On his final return voyage from India in 1656, the ship Mundy was in called at Ascension on 7th June or in June, and he relates how 'Some of our company went up (the Hills) and brought downe . . . halfe a dozen of a strange kind of fowle, much bigger than our sterlings ore stares: collour gray or dappled, white and blacke feathers intermixed, eies red like rubies, wings very imperfitt, such as wherewith they cannott raise themselves from the ground. They were taken running in which they are exceeding swift, helping themselves a little with their wings (as it is said of the estridge), shortt billed cloven footed, thatt can neither fly nor swymme. It was more than ordinary dainety meatt, relishing like a roasting pigge. . . .

* A complete copy of these journals is in the Bodlean Library, and some parts are in the British Museum.



J. & W. G. S. & D. M. S. Ltd. London

DRAWINGS BY PETER MUNDY

'I have heretofore asked the question concerning Mauritius henns and dodos, thatt seeing those could neither fly nor swymme, being cloven footed and without wings on an iland far from any other land, and none to be seene elce where, how they shold come thither? (see vol. ii, p. 318). Soe now againe concerning the Ascension birds allsoe that can neither fly nor swymme. The iland being about 300 leagues from the coast of Guines and 160 leagues from the iland of St. Matheo, the nearest land to it, the question is how they shold be generated, whither created there from the beginning or that the earth produceth them of its owne accord, as mice, serpents, wormes, etts. insects, or whether the nature of the earth and climate have alltred the shape and nature of some foule into this, I leave it to the learned to dispute of. . . .'

These remarks, together with Mundy's sketch, make it evident that this bird must have been a Rail which is now extinct. The island of Ascension is of volcanic origin and is more or less a barren cinder desert with the exception of the hills, where there is a certain amount of undergrowth and moisture which would give cover and feeding to a small Rail. None of the other early voyagers who visited the island mention any indigenous land bird. A flightless Rail would be easily exterminated by the rats which for long have been common on the island, and were possibly first introduced when Dampier was wrecked there in April 1701.

In the S. Atlantic Ocean an entirely black small flightless rail still exists on Inaccessible Isle, discovered in 1923 and described by Dr. P. R. Lowe as *Atlantisia rogersi*. On Tristan da Cunha there was formerly a black Moorhen, *Porphyriornis nesiotis*, very similar in appearance to the European Moorhen, which became extinct through the introduction of rats about the middle of the last century, and on Gough Island the closely allied *P. comeri* still exists.

Sea Elephant on St. Helena. By Mr. F. C. FRASER.

ON Mundy's return voyage from India in 1656 the *Aleppo Merchant* called at St. Helena, and Mundy went on shore for a walk, he says:—

'Beeing sett on shore near Chappell Vally, as I went along uppon the beach, I saw a strange creature (Pl. 2. fig. 2) lying along thereon, and as I drew near, I perceaved it was alive. It was very weake and (as afterward was found) hurtt in divers places. However, when I touched it, raised his forepart, gaping on mee with his wide and terrible jawes. It had the coullor (yellowish) and terrible countenance of a lion, with four greatt teeth, besides smalle, long, bigge smelling hairs or mustaches. Afterwards itt made way towards the sea, when I tooke uppe a good bigge stone (and) with both my

hands flung it att his head, which staggered him, and then with more stones made quite an end of him ; in length aboutt ten foote and five foote aboutt the middle. Some say it was a seale, others notte. I terme itt a sealionesse, beeing a femall. There wee left itt, beeing near after the forme hereunder : the haire very shortt, butt the mouth exceeding wide, wider then here sett downe, according to proportion of the rest.'

Although it is far to the north of the known distribution of the Southern Elephant Seal, *Mirounga leonina*, the drawing and description given by Mundy suggest that the seal he saw belonged to this species rather than any other. These animals, which are now mainly confined to South Georgia, Heard, and Macquarie Islands, have been recorded from Tristan da Cunha and as late as 1926 one was killed on the South African coast. They are very strong swimmers, capable of covering great distances, and it is just possible that one could have reached St. Helena. The wrinkling of the proboscis shown in the drawing, and the description of colour, noticeable canine teeth, and the behaviour of the animal when touched all suggest to me an Elephant Seal. I would say a young male—not female,—the sex could easily have been mistaken.

Lydekker (P. Z. S. 1899, p. 797) states that no seals are known from St. Helena. His paper deals with 'The supposed former Existence of a Sirenian on St. Helena', and instances among others a Sea Cow killed in 1739 while it was lying asleep *on the beach*. The animals were killed for their oil, and a government duty had to be paid on them. Lydekker's objections to the animals being seals are: (a) the name Sea-cow was not to his knowledge popularly misapplied to seals; and (b) too much importance must not be attached to the record of this animal sleeping on the beach, as it is mainly negative evidence, and, on the other hand, might not hold good for a supposed extinct species of Sea-cow which might have behaved in this way.

In favour of the idea that these 'Sea-cows' were seals must be considered: (a) the fact that one at least did haul out on the beach; (b) the recorded quantities of oil extracted from carcasses suggest the abundance in which it is present in seals; (c) the Mundy record which is definitely that of a seal.

Furthermore, Lydekker seems to have overlooked what Dampier had to say on the subject when he visited St. Helena in 1691. According to the old records of the St. Helena Government, as quoted by Lydekker, two men were convicted in the previous year for not paying duty on the oil they had obtained from a 'Sea-cow'. Dampier must have known of this, since he says:—

'I was also informed that they get Manatee or Sea-Cows here, which seemed very strange to me. Therefore enquiring more strictly into the matter, I found that the Santa Hellena Manatee to be, by their shapes and manner of lying ashore on the Rocks, those creatures called Sea-lyons; for the Manatee never came ashore, neither are they found near any rocky shores as this Island is, there being no feeding for them in such places. Besides in this Island there is no River for them to drink at, tho' there is a small Brook runs into the Sea, out of the valley by the Fort.'—'Dampier's Voyages' (Masefield ed.), p. 526.

Whale at Greenwich. By Mr. F. C. FRASER.

Mundy, in his diary, gives a very full description of the whale stranded at Greenwich, the occurrence of which is already well-known from the account given by John Evelyn in his Diary. Mundy's description is as follows:—

Pp. 96-8.—'3 June 1658. A whale (Pl. 2. fig. 3) came up in the river of Thames, betweene Blackwall and Greenwyche, where it was killed by the watermen. The like hath nott hapned in no mans daies now living, nor to be found on record. It was 58 foote long, measured 12 foot high (Evelyn says 16 ft.) and 14 broad. Shee had very smalle eyes which lay very near the ground, one beeing on both sides of the head, shee lying on her belly (for they say it was a female) a deformed head, different in shape from thatt of other fishes, as is the head of an elephantt from those of other foure footed beasts, butt their bodies somewhat alike. Shee had two holes in the upper part of her head, out of which shee spouteth wind and water, which I have often seene at sea. In one of the said holes or nostrills they had flung in a small anchor. The fynnes or whales bone grow in the upper jaw, which falleth in and is inclosed by the neither. It seemes to be a yong one by the smallness and shortnesse of the said fynnes, by computation not above 4 or 5 foote in length (whereas I was enformed there are of 10 foote long and 10 inches broad at the roote and soe lessning), growing downeward from the upper jaw, enclosed by the neither as abovesaid, close placed one by another edgewise, the thicker edge outward, the thinner withinside, all hairy. Soe that I conceave a very small fish or worme can hardly gett forth, beeing enclosed, yet may the water straine through, somwhatt after the forme following, as I saw it the first tyme the 4th June.'

Mundy's explanations of his drawings of the Whale are as follows:—

'No. 1. Att *a* is her upper jaw with the finnes or gilles fastned therin, with their points growing downeward, falling into the under jaw and enclosed therin. [See Pl. 2.]

'No. 2. As I saw her the second tyme, the 6th June, when shee lay on her side, her backe this way (a) her upper jaw (b), her nostrills (c), her eye (d), her paunch or maw spewed up with some of her gutts, as we many times see in fresh cod. Some may imagine it was her tongue, but this was to(o) much for her mouth to conteyne, so that it forced open her jawes and bent the fynnes for want of roome, beeing puffed up with wind, for the tyme I saw her first I thrust my arms into the mouth of her and could not reach to touch her tongue, only felt the inseed of the fynnes all hairy, the tongue lying deeper in the head.

'No. 3. Is only how I conceive shee openeth her mouth and swallows in the smalle fish, as allsoe how she bloweth outt wind and water.

'Concerning the whale, Mr. Purchase in his *Pilgrimage* saith (page 816) thus from the relation of others, viz: His head is one third part of him, his mouth 16 foote wide when open, of fynnes about 500, from 14 foote, lessning in length and proportion; his tongue may waigh 8 tons (roote and all), outt of which is made from 6 to 11 hogsheds of oyle. His great head hath little eyes, not much bigger than those of an oxe (the like hath the elephantt), his body round, 14 or 15 foote thicke; his pizzle hangs from him as a beasts. In generating they joine belly to belly, as it is said of the elephant. The shee hath two breasts as big as a mans head, with white milke, the ordinary length, 60 foote; swallow tailed, 20 foote broad, yeilding commonly 16 tonnes oile, sometimes more.'

The description of the Whale and the drawings are, on the whole, correct, the latter are certainly very much better than some sent in at the present time. The animal was an adult Atlantic Right Whale, *Balaena glacialis*, not a young one as Mundy supposed from the length of the 'fynnes,' or whalebone. Mundy was comparing the length of the whalebone with that given in Edge's description in 'Purchas his Pilgrimes'—Edge's description is of a Greenland Right Whale, in which the baleen is very much longer.

Fig. 3 (Pl. 2.) is very good. The emargination of the flukes is over emphasized. The two other drawings given by Mundy have not been reproduced, owing to lack of space. That of the tongue shows it in an inflated and extended condition as commonly seen in decomposed Cetacea. This could easily have happened between Mundy's first and second visits to the carcass.

The third figure represents the whale about to feed on a shoal of fishes and, though Mundy was wrong as regards the actual food, his description of the feeding mechanism

in whalebone whales is correct, and he is probably one of the first to have given a true account.

EXPLANATION OF PLATE 2.

These figures have been copied from the drawings made by Peter Mundy in his diary. That of the Seal and Whale are slightly reduced, but that of the Rail is the exact size.

Miss L. M. ANSTEY stated that the manuscript left by Peter Mundy was first brought to the notice of the late Sir Richard Temple by Sir William Foster in 1902, and from that time Peter became his pet child among the many records that he edited. Mr. Kinnear has emphasized the traveller's remarkable powers of observation, and his avidity to examine and endeavour to understand everything that he saw entails a wide field of enquiry for his editors. In fact, without the help of the many willing experts who have been laid under contribution during the issue of the volumes, it would have been impossible to complete the work. A special indebtedness is due to the British Museum (Natural History) for the unfailing assistance it has afforded. For one mistake, however, the traveller would not forgive his editors. In the introduction to the second volume he is credited with a wife and two sons on the assumption that he was the Peter Mundy who married Anne Bolitho. Internal evidence of the last volume, now being prepared for press, proves conclusively that Mundy died a bachelor, but the actual date of his death is still among the unsolved puzzles.

Sir WILLIAM FOSTER (President of the Hakluyt Society) emphasized the value of Mundy's narratives, inasmuch as he was a careful observer and his notes were made on the spot. These characteristics lent, he thought, especial weight to his statements on points of natural history.

Mr. EDWARD LYNAM (Hon. Sec. Hakluyt Society), Mr. W. S. ROWNTREE, and Mr. M. A. C. HINTON also spoke, Mr. Kinnear replying.

Notes on *Argiope bruennichi* and other Pyrenean spiders.

By Mrs. MARY J. MARPLES, B.A. (Communicated by Dr. W. T. CALMAN, F.R.S., P.L.S.)

Dr. S. FINNEGAN, on behalf of the author, stated that observations on the habits of *Argiope bruennichi* were made during a short visit to the Pyrennes and subsequently on some spiders brought back to England. The female, a brilliant yellow and black spider, makes an orb web with a platform of loose network in the centre, and frequently above and below this a vertical line of zig-zags of thick white silk. The spider takes its position in the centre of the web, the whole forming

a conspicuous object in the field. The male is smaller than the female and constructs a similar but much smaller web; sometimes the male is found in entanglements of the female web. There is considerable variation in the method of construction of the webs. Grasshoppers are the chief food of *Argiope bruennichi*, and the capture of them was observed many times. The cocoon is a flagon-shaped vessel closed by a yellow silk pad. The outer covering of the cocoon is thin and papery. Inside, the spherical egg-case, also with a sunk lid, was suspended by threads from the neck of the flagon. A few observations were made of *Argiope lobata* and *Clubiona phragmites*. Sweeping was the method used in collecting. In the analysis of the collections a large number were found to be young specimens, and Epeirid spiders predominated.

The structure of the ovary in the genus *Plantago* L.

1. The British species. By Miss RUBY E. DOWLING.

In view of the number of conflicting statements regarding the structure of the ovary of *Plantago* a re-examination of this organ seemed desirable.

In the five British species the ovary is bilocular, the axile placenta dividing the capsule into an anterior and posterior locus.

In *P. major* the ovules are approximately equal in number in each locus and are arranged in two tiers. A large number of abortive ovules is frequently found.

In *P. media* there are usually three ovules in each locus, two at the top of the capsule and one below. Abortion of some of these ovules is frequent and a one-seeded condition often prevails.

In *P. Coronopus* there are five seeds in the capsule—two in the posterior and three in the anterior locus. Four of the seeds are in the lower part of the capsule and one is at the top. It is suggested that the upper seed may represent the sole surviving member of the upper tier of seeds found in *P. major*. Abortive ovules are rarely found in this species.

In *P. maritima* three ovules are usually produced, two in one locus and one in the other. This ovule is nearer the top of the capsule than are the others. In general, only one ovule reaches maturity.

In *P. lanceolata* two ovules are formed, but in more than 50 per cent. of the capsules examined only one ovule reached maturity.

It is suggested that these five species present a series showing gradual sterilization of the ovary.

Dr. A. B. RENDLE remarked that it was of special interest that the detailed study of the ovary and ovules in the British species of *Plantago* confirmed the validity of the old Linnaean species and our modern concept of them. It did sometimes happen that extended investigation demanded a revision of generally accepted ideas on specific values.

Mr. H. W. PUGLSEY asked whether, in the examination of the ovary of *Plantago maritima* L., the mountain as well as the shore forms had been considered.

Mr. J. RAMSBOTTOM asked whether in using the term 'series' the speaker attached any evolutionary significance to the arrangement of the species or whether she merely referred to an arrangement of the species convenient for description.

Prof. E. J. SALISBURY asked the authoress a number of questions.

Miss DOWLING, in reply to Prof. Salisbury, said that *P. major* and *P. media* both show morphological polymorphism of the seeds, which may be due to nothing more than mutual pressure in the capsule. *P. Coronopus* shows both morphological and biological dimorphism: upper and lower seeds differ in shape and size and in their reaction to exposure to water. They also exhibit different dispersal mechanisms and correlated with this a difference in the time of germination. In regard to the degree of abortion of ovules the different forms of the species were not, in general, considered separately, but all the habitat forms of *P. Coronopus* show the same number and arrangement of seeds.

In reply to Mr. Pugsley, she stated that all the specimens of *P. maritima* examined were maritime plants.

The term 'series', referred to by Mr. Ramsbottom, was used to signify the arrangement of the species under examination in the order of the number of ovules produced by the ovary.

The inheritance of a substance in the roots of seedling hybrid derivatives of *Lolium perenne* L. $\times$ *Lolium multiflorum* Lam. causing a fluorescent reaction visible in filter-paper by screened ultra-violet light. By Mr. A. H. R. WOODFORDE.

THE Botanical Secretary, on behalf of Mr. Woodforde, stated that recent investigations by Linehan and Mercer and by Foy indicate that the degree of potential perenniality of certain seed-strains of *Lolium perenne* may readily be determined by examination of seedlings grown on white filter-paper, by screened ultra-violet light of wave-length 3,000–4,000 Angstrom units.

Lack of perenniality is considered to be associated with a certain proportion of seedlings whose roots cause the paper to exhibit fluorescence. The pseudo-perennial or false strains were supposed to have been derived from natural intercrossing of *Lolium perenne* and *L. multiflorum*.

The present paper reports the results of hybridization experiments carried out with selected plants of *L. perenne* and *L. multiflorum*. A variable hybrid generation was secured, and it was shown that this was due to heterozygosity of some of the parent material. A study of second generation material resulted in an observed segregation ratio of 3·4 : 1 from 'fluorescent' hybrid material. Similar material when back-crossed to the recessive gave a ratio closely approximating 1 : 1. 'Non-fluorescent' hybrid and parent material, on crossing with recessive plants, gave a totally 'non-fluorescent' population. 'Fluorescence' is thus a simple Mendelian dominant, inherited on a single factor basis, and thus the theory of hybridization, upon which depends the value of the ultra-violet light method of distinguishing between short-lived and persistent strains of perennial rye-grass seed, has been confirmed.

Italianate characters are dominant in the hybrid generation, but there is so far no evidence of complete dominance of the annual or biennial habit associated with *L. multiflorum*.

There is no genetic linkage between fluorescence and awned flowering glumes.

Miss MAY RATHBONE asked if the substance causing fluorescence occurred in *Lolium multiflorum*; to which Mr. RAMSBOTTOM replied that it occurred in over 83 per cent. of the seedlings, and probably its absence in the others was due to crossing with *L. perenne*. It was found in 2 per cent. of *L. perenne* seedlings.

The following papers were read in title :—

'Some eco-climatic data for closed evergreen forest in Tropical Africa.' By R. E. MOREAU, C.M.Z.S., M.B.O.U., East African Agricultural Research Station, Amani. (Communicated by WILLIAM NOWELL, C.M.G., D.I.C., F.L.S.)

'A collection of Bryozoa from South Africa.' By CHAS. H. O'DONOGHUE, D.Sc., and DORA DE WATTEVILLE. (Communicated by Dr. STANLEY KEMP, F.R.S., Sec. L.S.)

24 January 1935

Dr. W. T. CALMAN, F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 10 January 1935, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Ivan Terence Sanderson, Douglas Stewart Raitt and Richard Holliday Pott; for the first time, in favour of Margaret Jean Dickson and Frances Mary Ongley Waight.

The President reported the deaths of Kenneth Kent Mackenzie, Henry Harwood Smith and John Fraser, Fellows of the Society.

The supposed discovery of Unicorns in Tibet.

By Mr. WARREN R. DAWSON, F.R.S.E., F.S.A. (Visitor).

I HAVE recently acquired a number of documents from the papers of Sir Joseph Banks, and amongst these there occur a letter and a drawing of considerable interest in the history of Zoology.

In 1820, Major Latter*, a distinguished officer in the service of the Honourable East India Company, then commanding the N.W. Frontier Station, sent a letter to Col. James Nicol, Adjutant-General at Bengal, asserting that Unicorns existed in a wild state in Tibet, and enclosing a drawing of one of these animals. Latter suggested that the matter should be brought to the notice of the Governor-General of India (the Marquis of Hastings and Earl of Moira); and this was evidently done, for the Governor-General transmitted to Sir Joseph Banks a copy of the letter, together with the drawing, doubtless with the intention of bringing the latter to the notice of the Royal

* Barré Richard William Latter, son of Thomas and Elizabeth Latter, was born 22 July 1777, and was baptized in the parish church of St. Marylebone on 5 September (in the Register, the first name is spelt Barry). He entered the service as an Ensign, 1796, becoming Lieut. in 1797, Capt. in 1805, and Major later in the same year. He commanded the Battalion at Titalayah from 1814 to 1822. I can find no record of his retirement or death.

Society. As Banks died on 19 June 1820, it is probable that the communication did not reach England till after his death, but, in any case, there is no record of the matter in the Royal Society's archives*.

The letter reads as follows :—

Titalayah, 17th February 1820.

My Dear Nicol,

If you think it worth while you can take an opportunity of mentioning to the Marquis of Hastings my having ascertained that the *Unicorn*, so long considered a fabulous Animal, actually exists in the Interior of Thibet and is well known to the Inhabitants.



This is a very curious fact, and it may be necessary to mention how the circumstances became known to me. In a Thebetican Manuscript containing the names of different Animals, which I procured the other day from the Hills, the Unicorn is classed under the head of those whose Hoofs are divided, it is called the One Horned Tso'po. Upon enquiring what kind of Animal it was, to our astonishment, the person who brought me the Manuscript described exactly the Unicorn of the Antients. It is a Native of the Interior of Thibet about the size of a Tattoo †, fierce and extremely wild, seldom if ever caught alive, but frequently shot and the flesh is used for food.

The person who gave me this information has repeatedly seen the Animals and eat the Flesh of them. They go together in herds like our Wild Buffaloes, and are very frequently to be met with on the Borders of the great desert about a Months Journey from Lhassa, in that part of the Country inhabited by the wandering Tartars.

Upon the Person being asked if he could draw the figure of one, he did so upon Paper and considering the roughness of the Execution, produced a striking Similitude of the Unicorn.

* I am indebted to Mr. H. W. Robinson, Asst. Librarian of the Royal Society, for having kindly made a search in the Society's records.

† Possibly a variant of *Katu* or *Doddu*, Indian native names of the Gaur (*Bos gaurus*), or more probably, as Dr. Stanley Kemp suggests, *Tattu*, Hindustani for 'pony'.

I observe in the Encyclopedia that the Unicorn is supposed to be the 'Oryx' or Indian Ass of Aristotle * who says it has but One Horn and also to be the 'Fera Monoceros' of Pliny †, both of which came from India. Pliny in his account describes the *great* black Horn and *Hog like Tail*. My informant who has repeatedly seen the Animal, described the Tail to be like that of an Hog, or rather of an Ass, and different from that of a Horse.

It must be remembered this Man knew nothing about *our* Unicorn, but merely gave the description of an Animal he himself had seen and was well acquainted with.

Sparman ‡ mentions that the Unicorn described by the Antients has been found delineated on the plain Surface of a Rock in Caffraria, and several people at the Cape told me the same.

Is it not possible that the Wild Ass and Unicorn in the Book of Job are one and the same Animal? If so, the description given in the 39th Chapter of Job, would commence at the 5th Verse and end at the 12th. Moses in blessing Joseph says: 'His Glory is like the firstling of his Bullock and his Horns are like the Horns of Unicorns, with them he shall push the people together to the ends of the Earth' §.

Balaam when speaking in his parable of Jacob and Israel says 'God brought him forth out of Egypt, He Hath as it were the strength of an Unicorn, he shall eat up the Nations his Enemies and shall break their bones and pierce them through with his Arrow' ||. David also says 'Thou hast heard me from the horns of the Unicorns' ¶, as having been delivered from great danger.

I know that Bruce endeavours to show that the Unicorn or 'Reem' of the Scriptures was the Rhinoceros, but the Unicorn of Thibet as described to me answers exactly to the account we have of the Animals in the Sacred Writings. Isaiah says 'And the Unicorns shall come down with them, and the Bulls with the Bulls, and their land shall be soaked with Blood and their dust made fat with fatness' **.

I have given these quotations to show that Unicorns are spoken of in the Scriptures as *herding together*, which they actually do, for the man himself particularly mentioned that they went in herds like our Wild Buffaloes. The Rhinoceros on the contrary is a Solitary Animal. In the Thibet Manuscript the Rhinoceros is called Seroo and classed with the Elephants &c^a. The Unicorn cannot be mistaken for the Wild Horse (well known in Thibet) and which is called by a different name and expressly mentioned under the head of Animals that have not the Hoofs divided, whereas the Unicorn has the Hoof divided.

If you think the above will be considered interesting, you can show this letter at some favourable opportunity to his Lordship. I have written to the Sachia Lama requesting him to procure me a perfect skin of the Animal, with the Head Horn and Hoofs, but it will be a long time before I can get it down, for they are not to be met with nearer than a Months Journey from Lhasa.

(Signed) B. LATTEr.

To L^t Col^l Nicol. Adj^t General.

* Hist. Anim. (ed. D'Arcy Thompson), 449 b, 20.

† Hist. Nat. xi, 106 (cf. viii, 79).

‡ Anders Sparman, 'Resa till Goda Hopps Udden', Stockholm, 1783; English ed., 'A Voyage to the Cape of Good Hope', London, 1785.

§ Deuteronomy xxxiii. 17.

|| Numbers xxiii. 22.

¶ Psalms xxii. 21. See also Psalms xxix. 6; xcii. 10.

** Isaiah xxxiv. 7.

Such is Major Latter's account. Amusing, or even ridiculous, as it may appear to us at the present day, it must be remembered that it was a serious communication sent by the Governor-General of India to the President of the Royal Society.

The drawing is here reproduced on a reduced scale. The original drawing measures 25×20.5 cm.

Prof. E. W. MACBRIDE said that he observed in the drawing of the Tibetan Unicorn exhibited by Mr. Warren Dawson there was a third toe projecting sideways besides the two toes forming the hoof.

Could the drawing possibly represent an impression produced on primitive mind by the *Rhinoceros tiorhinus* which formerly inhabited the plains of Central Asia?

Capt. F. KINGDON WARD: The unicorn of Mr. Dawson's exhibit is said to inhabit the great Tibetan plateau, which occupies three-quarters of the country. Up to the end of last century, when Lhasa was still the objective of explorers, this was the best known part of Tibet. Being uninhabited, except by nomad tribes, travellers were able to proceed without interference, and even to approach Lhasa itself from the north, before being stopped. Yet not one of the plateau travellers, Bower, Wellby, Deary, Rockhill, or Sven Hedin, mentions the unicorn. Rawling* says briefly that they reached a place which Huc had declared to be the home of the unicorn. Prejevalsky†, however, has something to say: 'Another prevalent superstition is that the orongo (*Antelope Hodgsoni*) has only one horn growing vertically from the centre of the head. In Kansu and Koko Nor we were told that unicorns were rare . . . but the Mongols in Tsaidam who are perfectly well acquainted with the orongo deny entirely the existence there of a one-horned antelope, though admitting that it might be found in south-western Tibet. Had we gone further we should probably have heard that it was only to be found in India, and so on till we arrived at the one-horned rhinoceros.'

But if travellers on the Chang Tang (where it is supposed to live) are silent about the unicorn, travellers in southern Tibet generally give it honourable mention. Thus M. Huc‡, who was nothing if not imaginative, wrote on his return from Tibet, about 1847: 'The unicorn which has long been regarded as a fabulous creature, really exists in Thibet.' He gives a picture, which might be a Tibetan antelope, but is really more like a goral, with one long horn. He then

* 'The Great Plateau' (C. G. Rawling).

† 'Mongolia' (N. Prejevalsky).

‡ 'Travels in Tartary, Thibet, and China' (M. Huc).

quotes M. Klaproth : 'The unicorn of Thibet is called in the language of this country serou . . .'; but that does not justify Holdich * in confusing the issue by identifying Huc's unicorn with the Himalayan serou (*Nemorhaedus bubalina*, according to Holdich), though he maintains that it answers generally to Huc's description ! Huc then goes on to say that Brian Hodgson procured a unicorn while he was Resident in Nepal, and sent the skin and *horn* (my italics) to Calcutta. He admits that it is a species of antelope, 'called tchirou in southern Tibet. . . . It is the same word with serou only pronounced differently. . . .' He adds that Dr. Abel had proposed the name *Antelope hodgsoni* for this 'unicorn.' 'Serou,' 'tchirou,' and 'chiru' are obviously the same word, and apply to the same animal.

Hooker † also mentions the unicorn, but only to state categorically that *Antelope hodgsoni* is the 'so-called unicorn of Thibet and of MM. Huc and Gabet's narrative—a name which the profile no doubt suggested'. His picture of the head of a Tibetan antelope with the almost vertical horns, one hidden behind the other in profile, illustrates this.

Lastly, there is Teichman ‡, also in southern Tibet. He too says that it is the Tibetan antelope, 'which gave rise to the story of the unicorn in eastern Tibet, the appearance of the head and horns when seen in profile being exactly that of a unicorn'. Teichman picked up a single straight black horn, and was told that it was a unicorn's. He adds that it was certainly an antelope's. Hooker and Teichman both give 'chiru' as the native name. Thus there is general agreement that the Tibetan Antelope (*Panthalops hodgsoni*) is the source of the unicorn myth. This animal inhabits the barren Tibetan plateau, especially around the scattered lakes, where there is grazing. Hence the name tsogo (in Tibetan, tso-dgo) meaning 'lake antelope'. This brings us back to my first statement, namely that the plateau travellers do not mention the unicorn. But they all mention the *Panthalops*, which is seen in great herds. The reason is that they saw them as antelopes, and not as unicorns. The unicorn story comes from those parts of Tibet where the *Panthalops* is rare ; and it has all the prestige of M. Huc's name behind it. I have frequently seen the Tibetan Gazelle (*G. pecticaudata*) in southern Tibet, but never the *Panthalops*, so I cannot claim to have seen the unicorn. The story illustrates once more the fallibility of human testimony, the credulity of men, and the love of the marvellous, recently observed in the story of the Loch Ness monster.

* 'Tibet the Mysterious' (T. Holdich).

† 'Himalayan Journals', vol. ii (J. D. Hooker).

‡ 'Travels in Eastern Tibet' (E. Teichman).

The PRESIDENT referred to the benefit Mr. Warren Dawson had conferred on the Society by his Catalogue of the MSS. of Sir James Edward Smith, the first President of the Society.

The Cambridge Expedition to British Guiana, 1933.

By Dr. G. S. CARTER.

Six months were spent in Guiana during 1933 by a party of four biologists. The chief object of the expedition was to make a rapid survey of the ecology of the fresh waters of a tropical forest country, an object which required simultaneous investigations of the chemical characters of the waters, of the distribution of their fauna and flora, and of the adaptations of this fauna and flora to the conditions of the environments. So far as time allowed, all these subjects were investigated.

The results of the investigation of the chemical nature of the forest waters was to show that in many ways they resembled the peaty waters of temperate moors. The mineral content of all the forest waters is very low, as it also is in moorland waters, but in several other characteristics—acidity, brown coloration, and low oxygen content—the resemblance between the forest waters and those of moors was much more marked in the stagnant waters of the forest pools and swamps than in the flowing waters of the streams and rivers. The only character in which the forest waters were found to be noticeably different from moor waters was their higher content of organic material.

The planktonic fauna and flora of the forest waters was found to be relatively poor in quantity, even where the absence of current made the development of a rich plankton a possibility. This was probably due, at least in part, to the low illumination of the stagnant forest waters, itself caused by the shade of the overhanging canopy.

Experiments were carried out on the physiology of the blood in the fishes of these waters, and it was found that the fishes of the stagnant waters possess a type of blood which, in its low sensitivity to the presence of carbon dioxide in the surrounding water, is adapted to the environment in which the fish live and differs from the blood of the fishes of the rivers and streams. Many of the fishes of these stagnant waters have developed the habit of breathing air, and in many of them internal organs of aërial respiration have been evolved. The possession of a blood insensitive to carbon dioxide is essential for efficient respiration in such organs, and it is suggested that the evolution of this type of blood was an essential preliminary step in the evolution of air-breathing of this type.

The accessory respiratory organs of two fishes, *Electrophorus electricus* and *Plecostomus plecostomus*, were investigated.

Professor E. W. MACBRIDE congratulated Dr. Carter warmly on the splendid work embodied in this paper. He was especially interested in the account which Dr. Carter had given of the adaptation of the buccal cavity of the electric eel to air-breathing and of its modified blood supply. He ventured to suggest that this piece of the work should be embodied in a separate paper so that it might be more accessible to ordinary zoologists like himself, who found difficulty in following the physical and chemical data contained in the main part of the paper. On one point he ventured to register a difference of opinion from Dr. Carter. Dr. Carter had suggested that the piscine ancestors of Amphibia had been taught to breathe air through the increasing foulness of the water in which they lived. Undoubtedly some of the Dipnoi had been taught to breathe air in this way. But, inasmuch as the great morphological feature distinguishing Amphibia from fish was the adaptation of the limb to progress on land, he thought it more likely that terrestrial life had been forced on primitive Amphibia through the drying up of the pools in which they lived. In the modern climbing Perch (*Anabas*) the young fish was entirely aquatic, but as it grew indulged in excursions on land to capture prey.

Mr. A. G. LOWNDES expressed his interest in Dr. Carter's paper, especially in that part of it which dealt with the analysis of the waters of the swamps etc. He called attention, however, to the supposed importance that was claimed for hydrogen ion concentration a few years ago, and hoped that the same battle would not have to be refought over *electrical conductivity*. Prof. Alphonse Labbé, in France, had even claimed that it was possible to convert one species of copepod into another by an alteration in pH.

Major R. W. G. HINGSTON expressed his pleasure at listening to Dr. Carter's most interesting paper. Some five years ago he visited British Guiana, but his business there was very different from that of Mr. Carter. He had to get to the tops of the trees, while Dr. Carter went to the bottom of the swamps. He was not, therefore, qualified to speak on the fishes. The one which came most vividly to his mind was the Perai, a savage blood-thirsty kind, which attacked any living thing that alighted on or fell into the rivers.

Dr. CARTER, in reply to Mr. Lowndes, stated that he made no claim that hydrogen-ion-concentration or electrical conductivity had any direct influence on the species, but the latter served as a useful method of expressing the concentration of the salts dissolved.

Botanical results of the Cambridge Expedition to British Guiana, 1933. By Mr. T. G. TUTIN.

COLLECTIONS of Plankton were made in various pieces of fresh water in British Guiana over a period of about four months, including the whole of one wet season and parts of two dry seasons. The collections from the rivers Mazaruni and Cuyuni were very poor, both in species and individuals, a species of *Tabellaria* and a species of *Lyngbya* being the only constantly occurring algae. The forest streams, from which collections were made, had a flora very similar to that of the rivers, but rather richer owing to the presence of bottom-living species. A grass swamp in which many samples were taken had a much more abundant flora, and showed well-marked seasonal variation. In the dry season Cyanophyceae were very plentiful and species of *Cosmarium* and *Desmidium* common; in the wet season Cyanophyceae became much less common, the species of *Cosmarium* formed spores and disappeared, while filamentous Chlorophyceae of several genera became abundant and the *Desmidium* persisted.

Collections of land plants were made which yielded a considerable number of new species, and indicate that, while the main types of forest described by Davis and Richards are remarkably constant, there is a local variation which gives to each of the large river valleys a distinct flora. A type of forest, previously undescribed, in which *Dicymbe corymbosa* Benth. is dominant, was examined, and it is suggested that this tree is invading land at present occupied by Wallaba forest.

A fortnight was spent in the Potaro valley, which has an interesting and little-known flora somewhat similar to that of the Rio Negro. A small savanna at the top of Kaietuk Fall on this river has a very rich and varied flora, most of the species being confined to small areas on the savanna, and many of them endemic. The flora of this savanna as a whole shows a striking relationship to that of the summit of Roraima, separated from it by about fifty miles of forest and about 7,000 ft. higher.

Dr. T. A. SPRAGUE referred to the general similarity between the savannahs of Brazil, Guiana, and Venezuela, many characteristic elements of the savannah flora being the same in these three areas; the forest vegetation which surrounds the stretches of savannah exhibits greater differences in its floristic composition in the three countries.

The floral morphology and cytology of *Elettaria Cardamomum* Maton. By Dr. P. J. GREGORY.

IN presenting the paper, Professor Gates referred to the interest attaching to this plant, the cardamon, which is grown as a crop in a limited area of the Malabar coast of

S. India. In the Zingiberaceae, the family to which it belongs, there is one fertile stamen, the remaining five stamens being variously altered. The floral development was investigated by means of serial sections and the course of the vascular bundles was carefully followed. The labellum, regarding the morphological nature of which different views have been held, is shown to consist of three parts. The middle portion is the anterior member of the outer staminal whorl, the other two members being staminodes. The two lateral portions of the labellum together with the posterior fertile stamen constitute the inner staminal whorl.

The two structures inside the labellum are found not to be staminodes or stylodes, but glands without a vascular supply. The essentially trimerous ground-plan of the Monocotyledon flower is thus preserved. The three carpels are shown to form a close spiral, visible only in serial sections, and the classical theory of the ovules as borne marginally on the carpellary leaves is adhered to. The wall of the inferior ovary is composed of an outer layer, which is a continuation of the axis, and an inner layer formed by the carpels. The discussion supports the theory of the flower as essentially a metamorphosed shoot.

In ovular development a wide tubular micropyle is formed, and the embryo sac is of the ordinary eight-nucleate type. Gigantic cells are present (especially in the perianth), which may be concerned in the secretion of an aromatic substance characteristic of the cardamon.

From a study of the pollen development and root-tip mitoses, the number of chromosomes is found to be $2n=48$, which number indicates that the plant may be tetraploid (4*b*). The chromosome numbers for two other members of the Zingiberaceae were determined. In *Hedychium Elwesi* $2n=66$, and in *Costus malarotiensis* $2n=18$. In these three species the chromosome number varies inversely as the size, *C. malarotiensis* having the largest chromosomes and *H. Elwesi* the smallest. Various other cytological details are given, and it is concluded that in meiosis the leptotene thread is double, while the split which occurs in a somatic metaphase is suppressed, owing to the pairing of the leptotene threads in the zygotene stage. The homologous threads begin to pair first at one end and then at the other. The appearance of chromomeres is found to be due to the double character of the leptotene thread, with the two halves twisted around each other.

The pollen tetrads are frequently formed with the two spindles in the same plane. The pollen-grains assume their reniform shape and become spiny while still within the spore mother-cell. Spiny pollen-grains have seldom been recorded in Monocotyledons.

7 FEBRUARY 1935

Dr. W. T. CALMAN, F.R.S., President,
in the Chair.

The Proceedings of the General Meeting held on Thursday, 24 January 1935, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted:—Geoffrey John Kerrich and Guy Walter Otter.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time, in favour of Margaret Jean Dickson and Frances Mary Ongley Waight; for the first time, in favour of May Sherwood Campbell and Edwin James Semmens.

The President reported the deaths of Robert Alexander Robertson and Mary Jane Longstaff.

For this meeting a series of exhibits had been arranged, and, after some of the exhibitors had made brief statements, the Meeting adjourned to the Library. The following exhibits were shown:—

Hybrid vigour in embryos of Zea.

By Dr. ERIC ASHBY.

Frequently the hybrids between two inbred parents of maize grow bigger than either parent. This vigour has been attributed to the union in the hybrid of factors favourable to growth from both parents. It has been found, however, that hybrid vigour in these strains of maize is merely the maintenance of an initial advantage of primordial size, present in the ungerminated embryo. The cause of initial hybrid vigour must be sought therefore in some event between fertilization and the setting of seed.

Leaf-polymorphism in the genus *Polypodium*.

By Mr. F. BALLARD (Visitor).

HERBARIUM specimens were exhibited to illustrate the wide range of form in *Polypodium* L. (*sensu lato*). Variations in frond shape were shown, including a wide-leaved species (*P. musifolium* Bl.), one possessing *Juncus*-like leaves (*P. bisulcatum* Hook.), another with finely dissected blades (*P. taxo-*

dioides Bak.), and a number showing sterile and fertile fronds of widely different appearance (*P. bifrons* Hook., *P. incurvatum* Bl., *P. Bakeri* Luerss., etc.). Several epiphytic species which had adopted the 'nest' habit were shown in which specialised barren leaves (*Drynaria pleuridioides* Pr.) or the bases of ordinary fronds (*P. coronans* Wall., *P. cyclobasis* Bak., *P. Meyenianum* (Schott) Hook.) are modified to act as traps for plant debris into which the roots of the plant penetrate.

Selective attacks of birds on butterflies : a new set of observations. By Prof. G. D. HALE CARPENTER, M.B.E.

MIMICRY, that is the deceptive resemblance of a palatable species to one, not nearly related, which is disliked, can be explained only if *all* known facts are considered, by the operation of Natural Selection. It is agreed that, among butterflies, the intricate phenomena must, if due to Natural Selection, be the result of predatory activities by birds. Therefore the importance of the question whether birds *do* destroy butterflies to a degree which is of selective value is manifest. While those who cannot accept the agency of birds claim that there is not sufficient *published* evidence, the Hope Department of the Oxford University Museum claims that such evidence exists, if it were put on record. But some field naturalists have thought such occurrences too commonplace to be worth recording. Moreover, one line of evidence, of which examples are constantly coming to hand, has only recently been recognized—namely the imprints of birds' beaks upon the wings, such as I exhibited last year at the President's Reception. The material now exhibited is the result of an observation in E. Uganda by Mr. T. H. E. Jackson, of Kitale, Kenya Colony, last year. He noticed wings of butterflies lying on the ground under a flowering tree, which attracted large numbers : he saw birds on that tree catch and devour specimens after pulling off the wings : he picked up a large number of these wings off the ground, some of which bear the imprints of the birds' beaks, and noted that certain species were eaten and others, which according to theory should not be eaten, were avoided. These observations were published fully in *Nature* of 3 February 1935.

Extrusion of oogonia (enclosed oospheres) in Fucaceae.

By Dr. E. M. DELF.

IN certain types of the Fucaceae with unisexual conceptacles and oospheres solitary within the oogonium, the mucilage of the inner layers of the oogonial wall extends and forms a stalk, one end of which pushes through the exochiton, carrying away part of it, and the other end remains attached to the

top of the oosphere. The free end becomes caught among paraphyses, or possibly attached to the wall of the conceptacle, and as the stalk extends the other end withdraws the oosphere from the exochiton, still enclosed in the inner gelatinous layers of the oogonial wall. This mechanism was illustrated by preparations of *Bifurcaria*, *Cystophyllum*, *Sargassum*, and *Marginaria*, with slides, drawings, and a model.

South Haven Peninsula Survey (Studland Heath, Dorset).

By Capt. CYRIL DIVER.

(1) MAPS showing: (a) the geology; (b) the growth of the peninsula by the addition of successive dune ridges between the years 1600 and 1933—and the consequent enclosure and conversion of a saltwater lagoon into a freshwater lake; (c) the distribution of the main vegetation types.

(2) The distribution of the genus *Crambus* (Lepidoptera) on the peninsula, and its range of tolerance illustrated by: (a) a frequency table demonstrating the habitat specificity of fourteen species; (b) distribution maps of the two ecological species-groups ('grass-limited' and 'heather-tolerant') compared with vegetation maps; (c) maps showing the discontinuous distribution of individual species populations; (d) photographs.

Two submerged 'moss-balls' from Lake Inawashiro,

Japan. By Mr. H. N. DIXON.

Two moss-balls were exhibited collected by Dr. M. Miyoshi, in L. Inawashiro, Japan. The balls consisted of fragments of a submerged form of *Dicranella squarrosa*, rolled together in the form of balls by the lake currents. Similar balls were exhibited for comparison, from the shore of the Mediterranean, composed mostly of fragments of *Posidonia*.

A case of Acarine hyperparasitism in coffee fields in

South America. By Dr. S. FINNEGAN.

THE coffee fields in Surinam are separated from each other by a system of canals. Shadow trees with long roots reaching the canal are planted between the coffee trees. Both the coffee trees and the shadow trees are subject to a root disease. From Dr. Bünzli's investigations it appears that the roots are attacked by an organism carried by a coccid, which is the food of an ant. The ant in the flying stage transports the gravid coccid, and starts fresh colonies of coccids in fields which would otherwise be protected by the irrigation canals. The ant is parasitized by a mite of a new genus.

Well prepared specimens of Indian Araceae, collected by Professor E. Barnes, Madras. By Mr. C. E. C. FISCHER (Visitor).

DRIED herbarium specimens of the family Araceae are usually unsatisfactory; the important diagnostic features are often hidden within the spathe, and tend to crumble with the lapse of time. The specimens exhibited were some of those collected by Professor E. Barnes, of the Christian College, Madras, in South India. They are beautifully prepared and preserved, and show all required details without further dissection. They have made it possible to clear up confusion due to inadequate material in connexion with two species, and have provided five new species of *Arisaema*.

Carl von Linné's Öländska Resa. Förrättad 1741. Edited by Dr. C. W. Forrstrand. Stockholm, 1910. By Miss M. L. GREEN.

THIS little work is the diary of Linné during his travels in Öland in 1741. It was printed in Stockholm in 1907, the bicentenary of the birth of Linné, and there was a re-issue in 1910. The corresponding MS. record from the Library of the Linnean Society was also on view in order that a comparison between the two could be made.

The bud-pollination and self-fertilization of *Melandrium noctiflorum* Fries. By Miss A. C. HALKET.

PHOTOGRAPHS and specimens were shown demonstrating the bud-pollination and self-fertilization of *Melandrium noctiflorum* Fries—the night-flowering catchfly.

Germination of *Parinarium* and *Thevetia* as further examples of the germination of seeds enclosed in stony endocarps. By Sir ARTHUR W. HILL, K.C.M.G., F.R.S.

FRUITS and drawings of *Thevetia peruviana* (Apocynaceae) were exhibited to show the splitting apart of the two halves of the stony endocarp on the germination of the embryo. The seed is enclosed by the testa, which is hinged along the median line, and on germination the two valves separate, much as an oyster can be opened, and thus the germinating seed is liberated.

Three species of *Parinari* (Rosaceae) were exhibited to show the cork-like stopper closing or plugging the cavity in which the seed lies surrounded by a soft brown wool. On germination the stopper is extruded like a cork from a bottle, and the seedling then effects its escape.

An exhibit of South African pelargoniums to show the diverse forms of leaf and general habit.—Living plants. By Sir ARTHUR W. HILL, K.C.M.G., F.R.S.

LIVING specimens of South African pelargoniums were exhibited to show the varied form of leaf in the genus—*P. zonale* with its orbicular-reniform leaf, *P. peltatum* ivy-leaf, and *P. radula* palmatisect. *P. ovalifolium* has both entire elongated linear lanceolate leaves and lanceolate pinnatifid leaves. In *P. rapaceum* the leaves are pinnatisect and much elongated, resembling those of a carrot, while in *P. pinnatum* the leaves are definitely pinnate like those of sanfoin. Some of these are tuber-bearing species; *P. cotyledonis* and other thick-stemmed species were shown as well as the cactoid *P. tetragonum*.

Cytological preparations illustrating the life history of Plasmodiophorales. By Dr. A. S. HORNE and Mr. P. C. R. WEBB.

FOUR of the six preparations exhibited showed four chromosomes in the haploid nuclei of *Sorosphaera Veronicae* (prophase, metaphase), *Plasmodiophora Brassicae* (metaphase), and *Spongopora subterranea* (teleophase). The remaining preparations (*Sorosphaera Veronicae*) showed nuclear fusion and four bivalents at diakinesis. All the preparations were sections of galls formed on the host plant, and illustrated stages described by Horne ('Nuclear division in the Plasmodiophorales,' Ann. Bot. xliv, Jan. 1930) and Webb ('The cytology and life-history of *Sorosphaera Veronicae*', loc. cit. xlix, Jan. 1935).

Various types of leaf-blades of the Gramineae.

By Mr. C. E. HUBBARD (Visitor).

[No abstract received]

Evolution of the involucre of bracts in the family Saururaceae. By Dr. J. HUTCHINSON.

THE evolution of an involucre of bracts from foliage leaves was demonstrated in this small apetalous family. Herbarium specimens showed its gradual evolution, the most primitive species being *Saururus cernuus* L. (Florida), with normal green leaves. An allied species, *S. chinensis* (Lour.) Baill. (China), showed the first modification, the uppermost leaf or leaves being white. In *Gymnotheca chinensis* Dene., also from China, the much reduced white leaves subtend the inflorescence. The final stage was shown by *Houttuynia cordata* Thunb. (China) and *Anemopsis californica* Hook. & Arn. (California), each with a whorl of white involucral bracts and a reduced spike, resembling a Ranunculaceous flower.

Chromosomes in the salivary glands of *Drosophila*.

By Dr. P. CH. KOLLER.

IN the salivary glands of the larvæ of *Drosophila*, the chromosomes, which are about seventy-five times the length of those in other tissues, show a banded structure. The width and spacing of the bands are characteristic and constant for every part of the chromosomes. In the salivary glands the chromosomes undergo somatic pairing. Individuals heterozygous in respect of the structure of the chromosomes show differences of sequence by changes of association. Pairing of chromosomes heterozygous for an intercalary inversion was demonstrated by aceto-carminic smear preparations.

Spiral structure of chromosomes in *Tradescantia*.

By Mr. L. LA COUR.

THE spiral structure of meiotic chromosomes in *Tradescantia* is revealed by treatment of pollen mother-cells with acid or ammonia fumes previous to fixation. The two chromatids can be seen coiled in close association. Slides were demonstrated showing coiling at diakinesis and the pairing of two fragments.

The Frilled Shark, *Chlamydoselachus anguineus* Garman : an addition to the British Fish Fauna. By Mr. J. R. NORMAN.

THIS specimen of the Frilled Shark (*Chlamydoselachus anguineus* Garman) was captured off the west coast of Ireland (53° North, 13° West) at a depth of 300-350 fathoms, and constitutes a new record for the British fauna. The species is known only from Japan and from the eastern Atlantic, and had previously been recorded from Norway, the Bay of Biscay, the Iberian Peninsula, coast of Morocco, and Madeira. It is a very interesting and primitive shark, characterized by its elongate body, terminal mouth, curious dentition, and by the presence of six gill-clefts. The present specimen was obtained for the British Museum through the kindness of Sir Arthur Smith Woodward, F.R.S., who found it in a fishmonger's shop in Haywards Heath.

A resistance porometer. By Dr. H. L. PEARSE.

EXHIBIT illustrating a method for determining the degree of opening of the stomata. A small glass chamber is attached to the leaf by a gelatine washer. By means of an aspirator a stream of air is drawn through the stomata into the chamber and thence through a piece of thermometer tubing, which acts as a capillary resistance. A manometer is inserted between the glass chamber and the capillary resistance, and

any change in the pressure recorded by the manometer gives a measure of the change in the stomatal aperture. One limb of the manometer is interposed between a parallel beam of light, which is focused on to a linear thermopile. The movement of the fluid in this limb controls the amount of light reaching the thermopile, and the changes in pressure are thus automatically registered by means of a recording millivoltmeter. The changes in the stomata are thus recorded.

A new British Mint. By Mr. H. W. PUGSLEY.

THIS Mint was found last September at Salcombe, South Devon. It is a hybrid between *Mentha rotundifolia* Huds. and *M. arvensis* L., a cross which hitherto has not been recorded for Britain, although plants of this parentage have occasionally been reported from France and Germany. Four distinct forms of the hybrid have been described, and of these the Salcombe plant agrees most closely with *M. Muelleriana* F. Schultz in Flora, 543 (1854).

A collection of letters and portraits mainly relating to American botany : together with Wedgwood medallions of Linnaeus and Sir William J. Hooker. By Mr. J. RAMSBOTTOM, O.B.E., Sec.L.S.

AN interesting collection of about one hundred letters and twenty-eight portraits, including Wedgwood medallions of Linnaeus and Sir William J. Hooker. The collection has been purchased for the Society's archives by means of subscriptions contributed by thirty-four Fellows of the Society.

Letter from Dawson Turner to William Borrer, junr., dated 26 July 1914, concerning his visit to Persoon. By Mr. J. RAMSBOTTOM, O.B.E., Sec.L.S.

THE following extract from this letter in the Society's archives is of interest, as it confirms some of the statements made by Fée in Giorn. Bot. Ital. 1846 :—

‘ Poor Persoon we [W. J. Hooker and himself] found at the Rue des Boulangers up two or 3 pair of stairs in a lodging as miserable as the name of the street wd lead you to expect. He is one of the most uncouth odd looking animals you can conceive, &, long as he has lived in France, he really spoke French worse in point of pronunciation than Hooker or I did. He seems to be on bad terms with the others, none of whom could or would tell us where he lived, so that we did not find him till the day I left Paris. At first he received us very ungraciously, complained of letters that had never reached us hav^g remained unanswered, was very sore at the neglect Dr. Smith had shewn him, & took it as a direct affront that a report of his death had been spread in London. We smoothed

him, however, & he was quite disposed to be kind. He was also willing to give & to shew us all he had, but his collection is really inferior to Dickson's in point of specimens & in a still greater state of confusion. Of his paper that describes a few new Lichens he had no copy, nor could one anywhere be got. The Variolariæ described in it he gave me, but I left them at Paris with the plants I gathered on the road, to be forwarded in a box of books, & they are not yet come. In reality, however, his knowledge is very superficial. Hooker is incomparably a better Cryptogamist. Excepting Persoon there is not that I can learn an individual in France who knows a word about Lichens or Mosses. . . .'

Second edition of Du Petit-Thouars, Hist. Veg. Isles austr. Afrique, 1805. By Dr. T. A. SPRAGUE.

THIS contains six plates not occurring either in ed. 1 (1804) or in ed. 3 (1806), among them being the type plate both of *Ochrocarpos* Thou. (Guttiferae) and of the original species *O. madagascariensis* DC.—See 'Kew Bulletin', 1934, p. 88.

The President, in moving a vote of thanks to the exhibitors, stated that the present programme of exhibits had been arranged as an experiment, and, if successful, one or two similar Meetings would be held each Session.

21 FEBRUARY 1935

Dr. W. T. CALMAN, F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 7 February 1935, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted :—William Thomas Stearn.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of May Sherwood Campbell and Edwin James Semmens; for the first time, in favour of Zafar Alam, Joseph Ivan Armstrong, and E. Phillips Turner.

The President reported the death of Charles Henri Marie Flahault, Foreign Member.

The PRESIDENT, in introducing Professor Othenio Abel, formerly of Vienna, and now professor of Palaeontology in the University of Göttingen, referred to the remarkable success which had attended his efforts in deducing from the fossil remains of animals their probable habits and mode of life, and in this way founding what was almost a new branch of science, to which the name Palaeobiology had been given.

The Pleistocene Mammals and their Relations to the Religion of the Palaeolithic Man of Europe. By Professor OTHENIO ABEL, Dr.phil., Dr.Sci.h.c., F.M.G.S., F.M.Z.S. (Visitor).

EVEN to-day among primitive peoples fossil remains of large Mammals, found in Tertiary and Pleistocene deposits, give rise to the idea that fabulous animals and giants have had a real existence. In former days * the discovery of big teeth, skulls, and skeletons of fossil Mammals more readily induced belief in the existence of dragons, lindworms, and giants. It is true that many stories of fabulous animals or giants, for example the fables of snake-like dragons, have nothing to do with discoveries of fossil bones, but those fables were modified, as has been proved, by discoveries of bones or teeth of fossil animals, found in caverns or in sands, gravels or clays of the tertiary and the quaternary period.

The fable of the dangerous lindworms originated as it seems in Scandinavia, the native country of all German peoples, and in Central Europe became modified and added to in mediaeval times. In Germany these fables and myths became mingled with fables of classical antiquity, brought by Christian priests to our countries, and modified by discoveries of fossil remains, regarded as remains of dragons, giants, or lindworms. Also the well-known myth of the Licorn or Unicorn, originating

* O. ABEL. Paläontologie und Paläozoologie. Kultur der Gegenwart. (Teil iii.—Abteilung iv. des Gesamtwerkes. B. G. Teubner's Verlag, Leipzig und Berlin, 1914, S. 303–394.)

—— Die Tiere der Vorwelt. (Aus: 'Natur und Geisteswelt', 399. Band, B. G. Teubner's Verlag, 1914, S. 30–52).

—— Die vorzeitlichen Tiere im Volksglauben und in der Sage. Verhandlungen der k.k. Zool.-Bot. Ges. Wien, Bericht der Sektion für Paläontologie und Abstammungslehre, Sitzung am 20. Januar 1915. 65. Band, 1915, S. (115)–(117).

—— Die Reste fossiler Tiere im Volksglauben und in der Sage. ('Die Naturwissenschaften', Berlin, vii. Band, 1919, 8. Heft, S. 113–117; 9. Heft, S. 141–146.)

—— Die vorweltlichen Tiere in Märchen, Sage und Aberglauben. (Aus: 'Wissen und Wirken', 8. Band, Karlsruhe, 1923, pp. 1–66, 8 Tafeln und 16 Textfiguren.)

—— Geschichte und Methode der Rekonstruktion vorzeitlicher Wirbeltiere. Jena, G. Fischer's Verlag, 1925, pp. 1–11, figs. 1–7.

—— Das Leben der Vorzeit und seine Erforschung. (Aus: 'Die Welt', Salzburg, 1932, Verlag R. Kiesel, pp. 1–13, figs. 1, 2.)

in East India, and at first related to the Indian Rhinoceros, soon became modified to a remarkable degree in classical antiquity, as is proved by the report of Ktesias, physician to king Artaxerxes II., and later by discoveries of the incisors of fossil Proboscideans. In the mediaeval age and later, until the XVIIIth century, such big incisors were thought to be the horns of the fabulous Licorn or Unicorn. Even to-day the farmers of Lower Austria near Vienna, if they discover an incisor of a Mammoth in the Pleistocene Loess, speak about such remains as remains of the Unicorn.

Another example is the Lindworm of Klagenfurt, Austria. In 1335 a skull of a Pleistocene Rhinoceros, *Coelodonta antiquitatis*, was found in the neighbourhood of Klagenfurt in Carinthia, and is still preserved in the collections of the chief town of Carinthia—Klagenfurt. This specimen, as documents testify, was used in designing the monument of the Lindworm, which was commenced in 1590 and finished in 1636, and the skull in that sculpture resembles in a remarkable degree that of a fossil Rhinoceros.

The myth of the one-eyed Cyclopes, as I stated in 1914, seems to be largely due to the discovery of skulls of fossil Proboscideans found in caverns in Sicily. We all know the old myth of the one-eyed Polyphemos; in the Odyssey a story was told of the one-eyed Polyphemos and of the struggle between him and Odysseus. In the Mykenian period living elephants were totally unknown among Mediterranean peoples; the discovery of a skull of a fossil elephant by stranded sailors in a cavern not far from the coast of Sicily would therefore give rise to a belief in the real existence of one-eyed giants, because the nostrils situated on the front of a Proboscidean skull, from the standpoint of an unskilled observer, are situated in almost the same position as the orbits in the human skull.

As I have demonstrated in various papers since 1914, the discoveries of skulls and other bones, made in the caverns of Europe, gave rise to the idea that these bones were the remains of dragons which lived in these caverns; and in this way was developed the belief in fabulous animals, inhabiting caves, kidnapping virgins, and guarding treasures, like the well-known dragon of the Nibelungensage.

Numerous caves, mountains, and mountain slopes have German names, such as 'Drachenhöhle', 'Drachenloch', 'Drachenwand', 'Drachenfels', etc., and these names in my opinion all owe their origin to discoveries of fossils, whose true nature was unknown to our ancestors.

In the mediaeval age and in the following centuries up till the XVIIIth very peculiar ideas were published about the fossil remains, found in European caverns or elsewhere in Pleistocene deposits. In the second half of the XVIIIth

century scientific research on the Pleistocene mammals was begun; but it was based chiefly on their morphological, stratigraphical, and phylogenetic relations, and the relations of these mammals to contemporary Man remained almost wholly unelucidated.

During recent years, the incessant efforts of palaeobiologists have brought to light a considerable number of new facts regarding the Pleistocene fauna, and have thereby greatly enlarged our knowledge concerning the mode of life of the big mammals of the Ice Age. To-day, we have not only arrived at a clearer understanding of the phylogenetic position of the mammals of the glacial epoch, we also know much more than we did formerly of the part played by the different species in their relation to the whole fauna of a given period and locality. But, better still, we have also penetrated the darkness surrounding the relations of Pleistocene mammals to contemporary Man.

These relations are not only concerned with the degree to which the mammals of the glacial epoch were game for Palaeolithic Man. We have known for a long time that the life of man during the Ice Age was mostly that of a hunter, and we have also long known what kind of game these hunters liked best. The relics which have been preserved to us at the different hunting stations, especially in the caves of Central Europe, have enabled us to clear up these questions.

Moreover, the methods of research have been improved and work has been increased to such an extent that we have obtained a clear insight into the different hunting methods of Palaeolithic Man, who was dependent on but very imperfect stunning, thrusting, and throwing weapons to kill his game, if he did not succeed in catching it in pitfalls, traps, and in snares. Only in the latter manner did Old Palaeolithic Man succeed in killing the bigger animals; for against these his hand weapons, still very imperfect in early Palaeolithic times, were of little avail.

There can be no doubt that in these periods the life of Man depended on continual big game hunting, and it is equally clear that his whole world of thought must have centred in and must have been dominated by his relations to the game he hunted. Only a short time ago we were not in a position to make positive and detailed statements as to how far the thought of Ice Age Man was dominated by his prey, and we had to be satisfied with mere conjecture.

Recently, however, it has been possible to produce more detailed and reliable proofs of the nature of the relations between Ice Age Man and the animals he hunted, by means of a very careful analysis of different findings and an increased carefulness in excavation work, and also by repeated pains-

taking examination of different finds, which in some cases have long been part of our collections. These researches afford an unexpected insight into the spiritual life of Old Palaeolithic Man.

Emil Baechler, of St. Gallen, Switzerland, was the first to begin such researches. During the years 1917 to 1921 he excavated a cave in Switzerland 7335 ft. above sea-level, the Drachenloch, near Vättis in the Tamina Valley. In the course of these diggings, not only were numerous stone and bone artefacts together with remains of Cave Bears brought to light, but Baechler discovered also several stone chests, built by Cave Bear hunters. The chests consisted of stones laid one upon the other and joined together so as to form walls, and they contained several (four to five) skulls of Cave Bears, most of them found together with the first two cervical vertebrae, and all of them arranged so as to point in the same direction. There could be no doubt that the Cave Bear hunter of the last interglacial period had decapitated the bears he had killed and had buried their skulls together with the still adhering first vertebrae in those stone chests, finally covering the chests with a large stone slab.

This was proof that Old Palaeolithic Man of the Mousterian Period must have connected certain cultic conceptions with the bear he had killed. For the first time an insight into the spiritual life of Old Palaeolithic Man in relation to his game Mammals had been gained *.

More information, pointing in the same direction, was then provided by the excavations in the Petershöhle in Franken in Southern Germany and in the Drachenhöhle near Mixnitz in Styria, which were carried out at approximately the same time.

Hoermann reported in 1922 and 1923 that he found in the Petershöhle no stone chests as neatly and regularly built as those discovered by Baechler in the Drachenloch in Switzerland, but in some lateral niches of the Petershöhle accumulations of bones were met with, which could only have been heaped up or thrown together by a Palaeolithic hunter. In those spots such accumulations could only have been formed by the hand of man, never by another agent such as running water. It was Ice Age Man, too, who had arranged the bone deposits in the Drachenloch near Vättis, where for instance 54 fibulae of the Cave Bear were found, all of them showing exactly the same orientation. In the Petershöhle in Southern Germany a rock niche, situated like a cupboard in the rock, contained five Cave Bear skulls, two thigh bones, and one brachial bone. All these pieces must have been put into

* Since the discovery of the 'Man of La Chapelle-aux-Saints', France, we have known that in these times Neanderthal Man had some burial cults.

this niche by Ice Age Man, as a deposit formed by water is quite out of the question.

An almost identical heap of skulls was discovered in 1920 in the so-called Abel Gallery, which is a lateral cave of the large Drachenhöhle (Dragon's Cave) near Mixnitz in Styria, and this was excavated by myself and my assistants in 1921. Although this lateral cave contained forty-two Cave Bear skulls, the corresponding parts of the skeletons were mostly missing. Only the long bones, like thigh bones, for instance, were to be found in a relatively greater number, in some cases in very peculiar arrangement, resembling those of the Drachenloch in Switzerland.

These three localities in Switzerland, in Germany, and in Austria already combine to form a definite picture. In these cases we have without doubt found skull and long-bone sacrifices of the Ice Age hunters, which must have been connected with their religious conceptions.

It is a most curious fact that, even in present times, ideas of this kind still persist. From reports on the tribes of Eastern Siberia and of Kamtschatka we know that the Giljaks, and especially the Ainos, even to-day hold in reverence not the Cave Bear, now of course extinct, but the Brown Bear, and this in a very curious manner. The skulls of the killed bears are held in reverence like relics; they are cut off from the dead animals and are kept in separate places—for instance, on scaffoldings built high up on a tree, like idols.

A Giljak would consider it an unpardonable sin to kill a bear without paying his respects to the animal in certain fixed terms. The bear does not lose by his being killed, even if he is eaten afterwards, if only the skull is severed from the body and is properly done homage to. For if this is done the soul of the bear will return to the Lord of The Mountain and of the Primaeval Forest, and the bear will report to his master how and in what manner he has been shown reverence; then the Lord of the Mountain, satisfied by the homage paid to his animal, will again send new bears to become the prey of the hunters.

Accordingly, the Siberian traveller Pfizenmayer never succeeded in getting a Tunguse to procure a bear's skull for him. For this, the Tunguse said, was a most dangerous thing to do and a great sin against the spirit of the former possessor of such a skull. The Tunguse keep the skulls of the bears they have killed in boxes of birch bark or in bundles of brushwood and fasten these, like the Ainos do, to little scaffoldings on trees in the forest.

Such customs are much more numerous and more widespread than the few examples given here can possibly show.

The three localities in Switzerland, Germany, and Austria

prove clearly that during the Mousterian period in Central Europe the killing of bears was accompanied by skull and long-bone sacrifices, sometimes resulting in a curious combination of skulls and long bones, as a discovery in the Drachenhöhle near Mixnitz in Austria proved; moreover, a short time ago, the younger periods of the Palaeolithic epoch of culture have yielded additional characteristic indications of the fact that the hunting tribes of this period must have connected quite definite and very curious religious ideas with the Cave Bear, and after his extinction with the Brown Bear. Like a flashlight, these facts permit us an insight into the religious beliefs of mankind as it was then—an insight of the utmost interest.

The skull and long-bone sacrifices of Mousterian Man belong to the last interglacial period. It was probably Neandertal Man who first connected religious conceptions with the Cave Bear. For although the three localities in the Drachenloch in Switzerland, in the Petershöhle in Franken, and in the Drachenhöhle in Styria have yielded no human remains, they yet entitle us to assume with a very high degree of probability that this old Palaeolithic hunter, who left, together with those skull sacrifices, numerous stone and bone artefacts for us to find, was indeed Neandertal Man. This is a theory which seems sufficiently proved if we consider to what cultural epoch these stone and bone artefacts belong.

At the beginning of the last glacial period there appears in Central Europe the Aurignac culture, built up by a Man who was vastly different from Neandertal Man and whose appearance was most probably due to an entirely new wave of immigration into Europe. The Aurignac period is distinctly characterised by its own type of artefacts, so very different from those of the Mousterian, and the stratigraphic disposition as well as the determination of its relative age have to-day been ascertained with incontestable precision.

The Aurignac period in France is characterized by the pictorial reproduction of Pleistocene animals which were the contemporaries of Aurignac Man. A few years ago, in 1931, when I spent some time in the South of France in order carefully to investigate the prehistoric drawings of animals, I was able to ascertain that there are several representations from the Aurignac period which must certainly be taken as pictures of the extinct Cave Bear, whilst among the representations of the younger Madeleine culture of France we find none but bear drawings which depict the Brown Bear (*Ursus arctos*), a species which is still living to-day. This statement is based on a careful analysis of the characteristics which distinguish the Cave Bear (*Ursus spelaeus*) from the Brown Bear (*Ursus arctos*), distinguishing traits which have been

reproduced in a surprisingly true manner by the prehistoric artists.

Such representations of bears are to be found on the walls of several caves in the South of France, and also as scratch drawings in outline on objects made of stone or bone.

Thus we have several 'galets' from the Abri of the Colombière near Poncin in the Département of Ain in the south-east of France. On these, among representations of many other animals, we also find some of bears. These galets are preserved in the collection of the University of Lyon. One of these is a chalk stone piece, discovered by Professor Lucien Mayet, Lyon, and Mr. Jean Pissot, Poncin. On this object there is engraved an excellent representation of a Cave Bear, and according to my comparative researches this is by far the best drawing of the Cave Bear, dating from the Ice Age, which we possess.

This object is, moreover, very remarkable in other respects. When turned about at an angle of ninety degrees, it shows the representation of a man whose outlines are partly the same as those of the bear engraving. The human figure is shown in profile seen from the left. In the region of the under-arm section, the left arm of the man corresponds to the right arm of the Cave Bear, and the hand of the man coincides with the hand of the bear. This is not all: a closer inspection of the numerous lines visible on the surface of this object reveals the fact that opposite the drawing of the man a figure of a woman is represented, whose thigh the hand of the man is gripping.

This is the first of the representations which show erotic relations between a pair of human beings and a bear in a curiously close connexion.

On a second object the relations which the prehistoric artist has tried to represent are shown even more distinctly. The object in question is the fragment of a mammoth bone, on which we distinguish first the outlines of a Cave Bear whose head and anterior part of the body are shown as seen from the left. This object comes from the same locality as that first mentioned.

This object again shows two representations of human figures in very close connexion with the bear drawing. A bearded man, seen from the right side, is drawn in such a manner that the profile lines of his back are identical with the lines forming the front profile of the Cave Bear's head. Here, too, the figure of the man is shown as stretching out his arms in front of him and again we find the figure of a woman who is held by the man. For if this representation too is turned about at a right angle, the character of the second figure discloses itself without doubt to be that of a woman.

These two representations of Aurignacian origin have already shown us that in this period Man brought certain erotic conceptions into connexion with the bear. But the fact that we have to deal here with drawings of such relations which were executed intentionally is stressed and appears in an even more drastic manner if we compare a third object from the station La Madeleine in France, at present in the collection of the Museum of St. Germain. This piece shows the engraving of a brown bear's head turned to the left, while in front of this head there are to be seen representations of human sexual organs, in fact, masculine and feminine ones. We are thus strongly inclined to form the assumption that these representations point to an erotic cult, which must have been connected with the bear, and this view is confirmed by two very curious representations on the two sides of a flat piece of bone which was found in the grotto of Mas d'Azil in the Departement Ariège in the South of France. This object, too, is in the Museum of St. Germain.

On each side of this flat piece of bone there is engraved the representation of a human figure. One of them represents the frontal aspect of a female, the other that of a man seen from the left. By the side of both these human figures a bear's paw is depicted, stretching towards the abdominal regions of these figures. The outlines of the paw reproduce quite clearly the characteristics of a hairy bear's paw.

The ethnographic examination of these objects has been carried out by Professor Koppers, and in the course of his work he has arrived at the following surprising results:—

According to reports by A. J. Hallowell in his paper 'Bear Ceremonialism in the Northern Hemisphere', published in 'American Anthropologist' in 1926, the Giljaks of Eastern Siberia show a strange blending of serious solemnity and erotic frivolity when a bear has been killed. When the meat of the animal has been cooked, bits of paws and of skin as well as the membrum of a bear killed on an earlier occasion are produced, these things having been kept and preserved for this purpose, and they then play a special rôle in the course of the killing feats which follow.

In 1930, Mrs. N. P. Dyrenkova, in her report on cultic customs of the Turks in the Altai Regions, states that the membrum virile of a bear plays an important part in the different bear cults. She writes:—'In both cults (that is, Bear and Horse), we may note the presence of sexual elements. During the Kam ceremonies Ulgen and Kočuganxan are worshipped among the Altai Turks, the chaman or one of those present makes certain movements while carrying a wooden stick representing the penis and called penis (Kočugan kan) '.

In this connexion I should like to point out that a conjecture of mine, of which I have spoken at an earlier date, gains much in probability; that is, my interpretation of the famous 'bâtons de commandement' or commanding staffs from different of the Central European Magdalenien localities as priapic representations, an opinion which is now shared by numerous prehistorians.

The two strange representations on the flat piece of bone from Mas d'Azil are now easier to interpret. It is possible that they are connected with initiation rites, but they may perhaps refer only to festivals after the killing of a bear. In this connexion other information on bear feasts among the Altai Turks, for which we are indebted to Mrs. Dyrenkova, is of heightened interest. She says:—'In the killing of the bear we find additional analogues, for the young hunters are induced to make movements similar to those in sexual intercourse, over the body of the bear, and on nearing the bear's den one of the old hunters stands behind the beginners and holds a twig opposite his penis as he pushes the young hunter'.

According to this information, we may be almost sure that the outline drawings of bears connected with erotic representations which have been preserved are proof of the fact that Man of the Aurignac period as well as Man of the Madeleine period connected religious and cultic conceptions first with the Cave Bear, and, after his extinction, with the Brown Bear. We have proof also that these ideas have survived, in the same way that the even older religious conceptions of Mousterian Man have survived in the form of identical skull and long-bone sacrifices of bears among the Giljaks and the Ainos—a survival over an almost inconceivably long period of the history of mankind, from the last interglacial period until this day.

In addition, we are in possession of some other representations of Ice Age man, which help to complete these results. In the Grotte des Trois Frères near Montesquieu-Avantès in the South of France, on one of the walls of the cave a drawing has been preserved depicting the killing of a bear, which is being stoned to death whilst streams of blood gush out of its mouth. This is another proof of the existence of a bear cult in this period, for amongst the many thousands of prehistoric drawings which are known to-day no other animal has been depicted in such a peculiar way.

These religious conceptions are also connected with the very strange representations of bears with masks. In the Grotte des Trois Frères the figure of a bear shows a bear with a wolf's head, and by his side a bear with a bison's tail is engraved on the wall of the cave.

Last year I referred to the strong probability that these combinations had some religious meaning, and in this respect also Professor Koppers has procured valuable parallels taken from Gondatti and Halowell on bear feasts of the Ostjaks and Woguls of Eastern Siberia. I may mention that, according to Patkanov, it is the custom amongst the Woguls at bear feasts to carry a big erected membrum virile made of wood, which is fastened to a girdle of limetree-bast. This is done by masked players.

That representations of the kind which I have tried to describe are found only in prehistoric caves on the walls and as stray finds is explained by the fact that these caves were not really used as home caves, but first and foremost as sanctuaries by Palaeolithic Man, in whose life they must have played an important rôle. This only will explain why in the Grotte des Trois Frères on the back wall of the cave the picture of a Shaman is found which was first described by Abbé Breuil and by the Comte Bégouen in 1920. In the same cave many hundreds of drawings have been preserved on the walls which we must interpret as hunting charms, as far as they were not meant for votive pictures. I should like to interpret as a hunting charm the picture of a wild horse standing in a pitfall, with throwing sticks and arrows drawn beside it.

In another cave in the Département Ariège in Southern France an example of picture-writing has been preserved, which I saw in 1931. The picture-writing is in the inner sanctum of the cave, situated above an altar, on which, if I may say so, sacrifices were perhaps offered. It begins on the left side with two curved rows, one above the other, each consisting of straight lines side by side. On their left side a sharp-pointed triangle facing to the left is drawn. Although this representation is almost two feet long, there can be hardly a doubt that it is meant to picture a hedgehog of considerably more than life-size. To the right this representation is continued by a row of vertical lines, running on in a straight line from the left to the right. Above the upper row of lines we find the representation of a throwing stick as we have seen it depicted in other caves of Southern France. Such throwing sticks were used to throw arrows. On the right side follows the picture of a headless bison, from whose shoulder some darts are sticking out.

This seems to say :—‘I am the God of the Arrows, who has taught you the use of throwing darts. In return I demand that you sacrifice to me the skulls of bison killed by throwing arrows’.

Here again we find religious conceptions in connexion with

skull sacrifices just as they have been preserved among several hunters' tribes of Eastern Siberia, thus, as I said before, living on through an almost inconceivable period in the history of the human race from the Ice Age to the present day.

BIBLIOGRAPHY.

- O. ABEL. How Neandertal Man hunted Cave Bears. *Natural History*, New York, vol. xxvi. 1926, no. 3, pp. 252-6, 7 text-figs.
- Das Lebensbild der eiszeitlichen Tierwelt der Drachenhöhle bei Mixnitz. In O. Abel und G. Kyrle, *Die Drachenhöhle bei Mixnitz. Spelaeologische Monographien*, vii. und viii. Band, Wien, 1931, pp. 903-5, Taf. 46, fig. 1.
- K. EHRENBURG. Vorkommen, Bergung und Konservierung der Fossilreste. *Ebenda*, pp. 297-304.
- O. ABEL. Paläontologische und prähistorische Studien in Südfrankreich. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien*, 82. Band, 1932, pp. 27-34.
- O. ABEL und W. KOPPERS. Eiszeitliche Bären Darstellungen und Bärenkulte in paläobiologischer und prähistorisch-ethnologischer Beleuchtung. *Paläobiologica*, v. Band, Wien, 1933, pp. 7-64, 1 Tafel.
- E. BAECHLER. Das Drachenloch ob Vättis im Taminatale, 2445 m. ü. M. und seine Bedeutung als paläontologische Fundstätte und prähistorische Niederlassung aus der Altsteinzeit (Paläolithikum) im Schweizerlande. St. Gallen, Schweiz, 1921, 144 pp., 28 Tafeln.
- Comte BÉGOUEN et Abbé H. BREUIL. Un dessin relevé dans la Caverne des Trois-frères à Montesquieu-Avantès (Ariège). *Comptes Rendus des Sciences de l'Académie des Inscriptions et Belles-Lettres*, Paris, 1920, pp. 1-8, 2 figs. en texte.
- Count BÉGOUEN. The Magic Origin of Prehistoric Art. *Antiquity*, March 1929, pp. 5-19.
- Abbé BREUIL et Comte BÉGOUEN. Nouvelle Gravure d'Homme masqué de la Caverne des Trois-Frères (Montesquieu-Avantès, Ariège). *Comptes Rendus de l'Acad. des Inscript. et Belles-Lettres*, 1930, pp. 5-8, 3 figs. en texte.
- K. HOERMANN. Die Petershöhle bei Velden in Mittelfranken. *Abhandl. d. Naturhistorischen Gesellschaft zu Nürnberg*, xxi. Band, Nürnberg, 1923, pp. 121-154, Taf. 41-47.
- L. MAYET et J. PISSOT. Abri-sous-Roche préhistorique de la Colombière près Poncin (Ain). *Annales de l'Université de Lyon*, (1) vol. xxxix., Lyon, 1915, 205 pp., 102 figs. en texte, pls. i.-xxv.
- J. VÉZIAN. A propos de l'Ourson de Montespan. *Le Rôle Magique de la peau dans l'Ethnographie. Revue Anthropologique*, Paris, 36 Année, nos. 4-6, 1926, pp. 1-4.

Baron A. MARSCHALL VON BIEBERSTEIN (Secretary to the German Embassy), on behalf of the German Ambassador, thanked the President for the kind invitation to attend the General Meeting. He thanked the Linnean Society and the University of Cambridge for the cordial reception they had given to Professor Abel. He pointed out that the German Ambassador and he thought that the co-operation between English and German scientists was one of the best means of furthering friendly relations between England and Germany,

and expressed the hope that they would have the pleasure of seeing as many English scientists as possible in Germany, where they would always find themselves welcome.

Sir GRAFTON ELLIOT SMITH, F.R.S. (Visitor): In the first place I must express my gratitude for being accorded the privilege of listening to Professor Abel's suggestive address, and I must congratulate him on his achievement in collecting such interesting evidence, and on his amazing ingenuity in suggesting interpretations of it. Although I have been interested in the speculation as to the part knowledge of fossil remains played in the origin of mythical monsters I cannot pretend that I accept the whole of the claims made by Professor Abel.

More than thirty years ago I saw a great deal of the late Dr. Charles W. Andrews when he was opening up the fossil beds of the Egyptian Fayum, and I remember with what delight he learned of the interest archaeologists were taking in his discoveries. I recall in particular his comments on the late Sir Ernest Budge's suggestion that the gigantic snake whose remains Dr. Andrews had found in the Eocene beds was the prototype of the mythical serpent Apep, which figures so prominently in Ancient Egyptian mythology. Many years later, when the remains of *Eoanthropus* were discovered at Piltdown, I spent a week every summer with Sir Arthur Smith Woodward, who was reading with great interest Gould's book called 'Mythical Monsters', in which the author was attempting to explain how important a part fossils played in the fashioning of dragons and their kindred. Examining such evidence as I could obtain, however, it seemed to me ('The Evolution of the Dragon' (1918)) that in the making of such mythical monsters the essential part was provided by living and not fossil animals, in particular the joining up of parts of different animals, falcons, eagles, lions, and fish to form composite monsters.

On the other side, I was unable to convince myself that there was anything in Pleistocene times that could be called religion or that people in so remote a period appreciated the real meaning of fossils and realized that they were the remains of creatures that had once been alive. However, Professor Abel has made out a good case for the supposition that the inhabitants of the Upper Palæolithic caves of France and Switzerland did attach particular significance to *Ursus arctos* and entertained beliefs which might be called primitive religion. What is particularly impressive in his argument is the analogy between the practices of the ancient cave-dwellers of Central Europe and those of the people actually dwelling in distant North-Eastern Asia. What adds to the strength of such analogies is the demonstration

Dr. Gunnar Andersson has given of the similarity of the customs of Early China with those of Western Asia and Europe.

Hence, if I cannot accept Professor Abel's theory as a whole, I must thank him for illuminating suggestions, which convince one that if the cave art of Europe is still an enigma there are possibilities of interpreting it.

Prof. E. W. MACBRIDE, Mr. M. A. C. HINTON, and Dr. A. T. HORWOOD also spoke.

Mr. W. P. PYCRAFT expressed the great pleasure he had derived from listening to the results of Dr. Abel's most important contribution towards our knowledge of the mentality of early Palaeolithic Man, and his dawning sense of reasoning power, which displayed a greater capacity for thinking than was perhaps generally realized. Dr. Abel had brought out, in a very convincing way, the earliest rudiments of the artistic and religious which have played so important a part in the development of the human race.

The following Paper was read in title :—

'Coleoptera associated with the giant Lobelias and arborescent Senecios of eastern Africa.' By HUGH SCOTT, Sc.D., F.L.S. (Department of Entomology, British Museum (Natural History); with a Supplement by Dr. MAX BERNHAUER (Horn, N.Oe., Austria).

7 MARCH 1935

Dr. W. T. CALMAN, F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 21 February 1935, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted :—Col. Charles John Bond, C.M.G., and Francis Hemming, C.B.E.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Zafar Alam, Joseph Ivan Armstrong and E. Phillips Turner ; for the first time, in favour of John Milton Offord and Florence Hannah Bacon Marsh.

The following candidates, whose names were read for the third time, were balloted for and elected Fellows :—Bertram Lloyd, Ronald Winckworth, M.A., Charles Edward Hubbard, Herold Georg Schweickerdt, B.Sc., Ph.D., Charles Hervey Grey, D.S.O., Reginald Akroyd, Humphrey Robert Hewer, M.Sc., Ivan Terence Sanderson, B.A., Douglas Stewart Raitt, B.Sc., Ph.D., Richard Holliday Pott, B.A., Margaret Jean Dickson, B.Sc., Frances Mary Ongley Waight, May Sherwood Campbell and Edwin James Semmens, B.Sc.

The President announced that further subscriptions were still required to complete the sum necessary for the purchase of a collection of manuscripts and portraits mainly relating to American botany, which together with two Wedgwood medallions, had been offered to the Society. (*Cf.* p. 56.)

Some results of an experiment on dominance in poultry, with special reference to polydactyly. By Prof. R. A. FISHER, F.R.S. (Visitor).

WHAT I have to say concerns mutations, but mutations viewed from an aspect so different from that of the exponents of the mutation theory that I must begin by emphasizing the contrast. Exponents of the mutation theory, such as T. H. Morgan (1), regard it as an alternative theory to Darwin's theory of selection. The course of evolutionary change is thought to be *explained* by mutations. If so, then necessarily mutations are the true agencies of the creation of living things. The mutant animal, or plant, as it appears in our cultures, should be regarded on this view as a step in evolutionary progress, new-minted, as it were, from the hand of the Creator. If theistically inclined, we should perhaps regard it with some awe—God's new idea for *Drosophila melanogaster*. At all events, they are regarded as the actual causes of evolutionary change—but are they? That is the question I want to discuss, and to answering which I hope such facts as I have to give may contribute.

The question deserves our most careful consideration, so careful that I must ask my audience to assist me in a very difficult undertaking. It is not that I mean to put forward any complicated argument—on the contrary, all I shall do is to describe a simple, though prolonged experiment, and to exhibit some of the results. The really difficult thing that I ask is to avoid *assuming*, at least during our discussion, either that mutations do, or that they do not, govern evolutionary change—to maintain an open mind on this point while the evidence is being considered, and so to give the evidence a fair chance of carrying whatever conviction it may be entitled to.

This caution is made necessary by the fact that the assumption is a very old one in biological thought. Whatever novel elements mutationists may associate with their evolutionary views, their basic assumption was taken for granted by the pre-Darwinian evolutionary writers. That stalwart Lamarckian, Samuel Butler, put it thus:—‘To me it seems that the “Origin of Variations”, whatever it may be, is the only true “Origin of Species”.’ Indeed, the assumption is implicit in Lamarckism. To the earliest writers the problem of evolution appeared merely to be one of explaining mutations, that is to say of explaining heritable innovations. Effort and striving, use and disuse, hormones, and orthogenetic urges are all attempts to set up such an explanation. All the time it was assumed that if the explanation *worked*, if the mutations were duly produced, then evolutionary change would follow. That the evolutionary effect should fail, even though the mutations were duly produced, was a possibility that never seemed to require consideration. So far from being a novelty, therefore, the mutation theory is rather a bare residuum of the older alternatives to natural selection, when each is stripped of its more distinctive features.

The very name ‘Mutation-theory’ must have a certain attraction for the leading workers with *Drosophila*, who have discovered so many mutations. Yet it does not follow that their discoveries support the theory. A survey of the mutations found in this fly reveals three outstanding facts, which, I believe, are not disputed:—

(i.) The mutations are found, some certainly, and the remainder probably, to be recurrent; many have appeared repeatedly in ordinary cultures, and others are found to be inducible at a measurable rate by X-rays. We should probably think of the whole group as occurring spontaneously at the rate of about one in a million in each generation. A few have higher rates, but of those with rates much lower it is probable that few have occurred, and been discovered, in experimental cultures. Mutations with much lower rates may therefore exist, but at present we can know nothing about them. The relatively frequent mutations which are available for study, have spontaneous mutation rates sufficient to ensure that many thousands, or more probably millions of mutations of these kinds occur in the species in every generation.

(ii.) They are, as a whole, markedly deleterious in their effects on the fly, often the effect is sublethal, while the largest class of those readily detectable is absolutely lethal in its effect.

(iii.) In their inheritance, the mutations are nearly all recessive. In a summary of 221 non-lethal mutations in *Drosophila melanogaster* I found 208 described as recessive,

while in the remaining 13, though they are conventionally called dominants, this only means that the heterozygote is distinguishable from the wild type, and not that it is indistinguishable from the homozygous mutant, from which, I understand, it differs in every case. In these cases, therefore, dominance is absent or incomplete. I understand that in other species of *Drosophila* there are a few cases in which dominance may be regarded as complete, but such rare instances, even if they are well substantiated, do not affect the general tendency for the recessives enormously to outnumber the dominants.

It is interesting to recall that East and Jones (3), discussing similar facts in maize, perceived that this immense preponderance of recessives required an evolutionary explanation. They suggested that, owing to the prevalently deleterious effect of the mutations, it might be accounted for by the selection of genotypes in which the mutation-rate of dominants was extremely low, while such adverse selection would be much less in recessives. I do not think that the selection of mutation-rates can itself be effective at the very low levels which these rates ordinarily possess, though it would be at higher levels. As I was led later (2) to suggest an evolutionary explanation of the prevalence of recessiveness among mutations by a somewhat different process, I should like here to acknowledge the priority of the interesting suggestion which East and Jones put forward.

My own suggestion was based on a very large number of observations, made since East and Jones wrote, showing that the effects of Mendelian factors, or, more concretely of gene-substitutions, can be largely modified by other heritable factors. One way of putting this is, that what we call the effect of a mutation should be regarded as the reaction of the organism as a whole to that particular gene-substitution, a reaction which naturally depends as much on the nature of the organism as on that of the substitution concerned. Another way of putting it is that the effects of a gene depend on the internal environment which the organism provides, and in which it exerts its developmental effects. In any case, it is abundantly proved that the same gene-substitution produces very different effects in different organisms, and that the effect of a Mendelian factor has frequently been much modified by intentional or unintentional selection.

My theory of the modification of dominance is merely the application of this general fact to that particular feature of a Mendelian factor which we call dominance—that is, to the extent to which the heterozygote resembles one of the two corresponding homozygotes more nearly than the other. The theory was put forward only after a deliberate examination

of the magnitude of the changes to be expected from the selection of factors affecting dominance, and after finding that, though these were very minute, they were yet of an order of magnitude which, unless some unknown cause opposed them, would certainly produce nearly complete or complete recessiveness in mutations which had persisted in occurring at the current rates for anything like a million generations.

The fact that different species show mutations which may be shown to be homologous seems to prove that many mutations must be extremely ancient; further, if we take the view that a mutation such as albinism is the same in different orders of mammals, or even in more distant vertebrates, we must think of this mutation as having continued to occur over an enormous period.

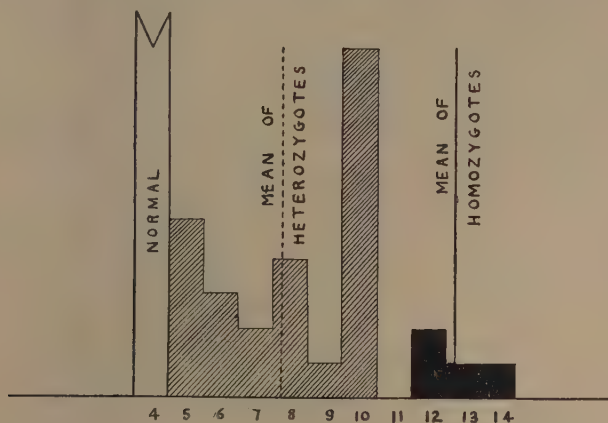
I need not now go into the further evidence which, since I originally put forward the suggestion, has extended the application of the theory of dominance modification to a range of phenomena, especially in the polymorphic species, much wider than that on which I originally put it forward. Let me turn at once to the case of domestic poultry, with which, since it was supposed to exhibit facts contrary to those on which my theory was based, I was led to commence experimentation about five years ago.

A large number of the factors in which domestic breeds differed from the wild jungle-fowl had been described by poultry geneticists as dominants. From the literature, one would judge that in many of these cases dominance was complete. In a number of cases it is now known that this impression is misleading, and factors like those for Frizzled plumage, for Spangle, or for Pea-comb can at once be set aside as showing no more complete dominance than do the *Drosophila* mutations. Nevertheless, it is clear that domestic poultry seem to differ from all other species equally thoroughly investigated, both in the large number of apparent dominants in the domesticated breeds and in the comparative completeness of the dominance when it was observed.

In puzzling over this exceptional state of affairs, it occurred to me that possibly human selection during the process of domestication had been responsible for both these features, and in particular that, if we suppose the jungle-fowl to have been brought into domestication, at first gradually, by jungle tribes, they could not, and would scarcely have attempted to, prevent their flocks from being freely covered by wild cocks. In these circumstances, the novelties, by which man is always attracted, could only be perpetuated if they were at least partially dominant; so that an excessive proportion of partial dominants might, for this reason alone, be expected

in our domesticated breeds. Further, if, as seems probable, selection was exercised among the offspring in favour of a more marked development of each characteristic, such selection applied to heterozygotes would constantly favour those modifiers which tended to make the factor more dominant or less recessive.

It was to test this possibility that human selection was responsible for the apparently exceptional genetic phenomena exhibited by poultry that I commenced, in 1929, to cross domesticated breeds, known to contain some of the best known dominants, back into the wild jungle-fowl. For, by introducing each of these supposedly dominant factors separately by repeated crossing into a wild strain, it seemed



that we should be able to ascertain what the genetic behaviour of the factor had been before any human selection had been exercised. The experiment was made possible by the kind co-operation of the Zoological Society and by funds generously supplied by Mr. J. Spedan Lewis and by the Royal Society.

In all I used seven supposedly dominant factors, of which three affected pigment, namely Pile or 'dominant' White, the sex linked mutant Barred, and the Black mesodermal pigment. Four affected structural characteristics, namely, Crest, Rose-comb, Polydactyly, and Feathered feet. For three of the seven factors tested, the results are so clear as to be already substantially complete, and these I have reported in a preliminary account now in the hands of the Royal Society. For the remainder, though I do not think

the results will show any substantial difference, it would be premature, at present, to report definite conclusions until test matings can be completed during the next two years. To avoid confusion, I will speak to-day principally of a single factor—polydactyly. I gave a full account of the results for Crest, which, incidentally, turned out to be the same as the recessive Hernia, at the Genetical Society last December.

Polydactyly was obtained from Japanese 'silky' pullets, which were crossed, in 1929, with a wild jungle cock from the Zoo. During the four next years, polydactyl offspring from the previous year were continually mated with a wild strain presented by Mr. Spedan Lewis. In the sixth year, 1934, polydactyl young were interbred for the first time, thus making possible the production of homozygous polydactyls. My experience in the previous years had been confined to heterozygous birds, and I had no idea what further modifications, if any, to expect. If polydactyly had been properly described as a dominant, the homozygotes should, of course, have been indistinguishable from heterozygotes, and I should merely have obtained a frequency ratio of three polydactyls to one normal.

The results of the crossings of the first five years were as follows :—

	Normal.	Polydactyl.	Total.
1929	17	17	34
1930	63	81	144
1931	—	—	—
1932	14	11	25
1933	6	4	10
	100	113	213

In 1934 four broods out of five showed feet of a new type, readily distinguishable from the heterozygotes. Of the chicks hatched there were six of these homozygotes out of twenty-five, or, including embryos which died in the shell, six out of thirty-one. Either proportion is as near as we should usually get to the 25 per cent. expected. Of the homozygotes, two pullets survive, and can be tested next year. Of the remaining four, which have died at various ages, I have preparations among the exhibits.

To appreciate the differences between the two types, it is necessary to examine the feet of birds known to be heterozygous in some detail :—

(A) Among these there are a few with normal feet. A small proportion, perhaps 10 per cent., but probably less, have both feet normal, and cannot be enumerated in the mixed broods. When one foot is normal and the other polydactyl, of which I have seven cases out of a sample of twenty-five,

the normal foot is always on the right side, in accordance with the rule stated by Bond in 1920 (7).

(B) Rarer in my material, even than normal feet, is a foot with four toes, but with an extra joint in the hallux, making two phalanges in addition to the metatarsal and the claw. In my sample of fifty feet this appeared only once; but I have other cases, and the frequency may be a little more than 2 per cent.

(C) A second type with three bones may be described as having a normal hallux, with an additional bone carrying a claw floating freely beside the phalanx or fused with the phalanx to form a Y. In this type, as in the last, one can count only three bones on the foot, apart from the claws. In my sample there were 28 per cent. of this type.

(D) The fullest development of the polydactyl foot in my heterozygotes has two halluces carried on different metatarsals, which may or may not be fused, and of these the outer or extra-hallux has always two phalanges, while the inner hallux is normal. There are, therefore, five bones to be seen in this type, which is the commonest, being found in twenty-eight feet out of fifty—or 56 per cent.

Apart from other variations, if we take the number of bones in this region, counting both feet together, as a quantitative variate, so that a normal bird has four bones, the numbers in my sample of twenty-five range from five to ten, with an average just under eight, so that the average, including a few birds normal in both feet, may be about seven and a half.

The birds presumed to be homozygotes in the 1934 broods are all characterized by having three phalanges in the extra hallux. In one case this is shown in only one foot, the corresponding terminal joints of the other foot being fused at a visible junction to form an abnormally long second phalanx. Neither foot would be mistaken for that of a heterozygote, for, in addition to the extra toe being long and stiffly articulated, the metatarsals of all the homozygous birds are abnormally large. Instead of resting against the cannon-bone, they project across or along it on the outside, so that they can be felt and seen on the outside of the foot. I have never seen this development in a heterozygote. The numbers of bones in the four available specimens are eleven*, twelve, thirteen, and fourteen respectively, the average being twelve and a half, to be compared with an average of seven and a half to eight for the heterozygotes and of four for the normals.

* These are the four homozygotes shown in the figure, p. 75; it is now clear that the bird to which the number eleven refers had these distinct phalanges in both extra halluces. The number should, therefore, be twelve, as shown in the figure.

The case is, therefore, a typical one of absence of dominance. The heterozygote is intermediate, and usually distinguishable from both homozygotes, though occasionally it resembles the normal. Such slight departure from complete intermediacy as exists is in the direction of recessiveness.

In its dominance, therefore, this factor bears out entirely the anticipations with which the experiment was planned, as do also the factors for Crest and Hernia and for Barred. The case of Crest is particularly interesting, in exhibiting a phenomenon the importance of which was first pointed out by Ford, in that, like several other mutations having more than one effect, it is completely recessive in the cerebral hernia, but shows lack of dominance in its relatively harmless manifestation—that is, in the crest itself.

The barred factor inclines, as the exhibits show, to recessiveness, though here again the heterozygote is clearly intermediate and distinguishable from both homozygotes. In this factor it is interesting that, since the barred female resembles the *heterozygous* male, the factor when introduced into wild stock produces a sexual differentiation, apparently the same as that which Punnett and Pease have utilized in the development of their new breed, the Cambar.

In the light of the reaction of the wild jungle-fowl to polydactyly, we may consider the three views which have been formed on the behaviour of this factor in crosses between domesticated breeds.

First, Bateson did not consider that dominance was imperfect in this case, but that its incidence was variable and irregular. He drew the distinction with some emphasis in 1909 (4, p. 53).

‘Imperfection of dominance does not even obscure the application of Mendelian analysis. The cases in which difficulty does arise are those in which dominance is irregular and the recessive class cannot be distinguished with certainty. In the fowl, for instance, the extra toe is usually a dominant, but in some strains there is irregularity, and birds without the extra toe may nevertheless transmit it.’

With respect to the cause of the irregularities he adds :—

‘It is not impossible that they may be ascribed to interference caused by the presence of other factors in various combinations, and sometimes, no doubt, to disturbance by external conditions.’

The next view I need quote is that put forward by Punnett and Pease, who assembled the results of a large number of matings involving this factor. Their conclusions are as follows (5):—

‘It is evident also that this factor can be carried by an apparently normal 4-toed bird. This is probably due to the

existence of a factor (or possibly factors) inhibiting the action of the factor for polydactyly, and this factor (or factors) may be carried by normal recessive 4-toed birds. Further, since the evidence points to polydactylous birds being also capable of carrying the inhibitor, we must suppose that we are also concerned with some other factor, or factors, rendering possible the manifestation of the polydactylous effect in spite of the presence of the inhibitor. But although we have devised various schemes along these lines we have not found one which we consider satisfactory. Our failure, however, has been due more to lack of necessary data than to antagonistic facts.'

These authors, therefore, seek to explain the apparent irregularity of dominance by postulating, *first*, an inhibitor capable of reducing genetically polydactylous birds to the four-toed condition, and, *second*, a super-inhibitor capable of permitting the expression of the five-toed factor, even when the inhibitor is present. I need only mention one consequence of this theory, namely that, if it were true, it must be possible to make up two strains, both uniformly four-toed, which on crossing will throw a proportion of five-toed young in the second generation. This has never been done. It must be possible further, by the use of the super-inhibitor, to make up two more strains, both uniformly five-toed, which on crossing will yield a proportion of four-toed young in the second generation. This also has never been done. Until at least one of these feats has been accomplished, it seems highly conjectural to postulate the existence of either of these inhibitors.

Immediately following the paper by Punnett and Pease, J. B. Hutchinson (6) put forward the view that the whole of the data could be simply explained without the aid of inhibitors, on the view that dominance in polydactyly varied in different breeds from almost complete dominance at one extreme to almost complete recessiveness at the other, these differences being due to modifying factors capable of influencing the degree of dominance of polydactyly. This proposal of Hutchinson's is in entire accord with the imperfect dominance found in the wild fowl and with the small proportion of heterozygotes with normal feet. It requires that in some breed-crosses this proportion is larger than I have found, and suggests that in other crosses the heterozygotes may overlap or even be indistinguishable from the homozygous polydactyls.

Let us now consider the mutant for polydactyly, in the light of the mutation theory, as a potential agency of evolutionary change. If the mutation, or something having like effect, did not occur in other birds and at other periods of the earth's history, it would be an odd coincidence that it should have

occurred in the particular bird of which we have the best evidence and in the human period. We should be straining at probabilities if we did not suppose that it occurred, perhaps with varying mutation-rates, in the other ten thousand species of birds, and had occurred throughout the fifty or hundred million years of their evolutionary history. I am told, in fact, that it has been found in ducks, and in pigeons, but I can say nothing of its inheritance in these species. If we admit this view as probable, we may ask, 'What has been the evolutionary effect of all this mutational activity?' and, as far as wild species are concerned, the answer is certainly that it has had absolutely no effect in increasing the number of toes. Something like a dozen species, say one per thousand, have lost a toe in the course of descent, and the ostrich is, I believe, unique in having lost two toes, but the extra-hallux has not established itself in even a single species. Of course, a *selectionist* would say 'Why should it?' but it is to mutationists that I put this case, as a fair sample of the efficacy of mutation as a means of controlling evolutionary change.

Selectionists naturally are not inclined to deny the importance of mutations in general as a condition of evolutionary progress in the future. This function is quite a different one from that ascribed to them by mutationists. However, ineffectual mutations may be as direct causes of evolutionary change, they serve, after the more definitely deleterious have been sorted out, to replenish the fund of heritable variation carried by every species, and to prevent that fund from ever becoming exhausted. This fund is the raw material from which further adaptive improvements can be fashioned. If, as is practically inconceivable, it could be exhausted, further selective improvement would cease. To acknowledge this is very far from admitting that the argument can be short-circuited to the conclusion that mutations are the effective cause of evolutionary change; for this would be to eliminate the whole chain of complex processes, by which differential rates of death and reproduction are brought about, and in turn modify the heritable composition of the species. It would be roughly equivalent, logically, to saying that the weekly toll of deaths on our roads is caused by the fact that wheels will turn on axles!

REFERENCES.

- (1) T. H. MORGAN. (1932.) *The Scientific Basis of Evolution*. New York.
- (2) R. A. FISHER. (1928.) The possible modifications of the response of the wild type to recurrent mutations. *American Naturalist*, lxii, pp. 115-126.
- (3) E. M. EAST and D. E. JONES. (1919.) *Inbreeding and outbreeding*. Monographs on Experimental Biology.

- (4) W. BATESON. (1909.) Mendel's Principles of Heredity. Cambridge.
- (5) R. C. PUNNETT and M. S. PEASE. (1929.) Notes on Polydactyly. *Journal of Genetics*, xxi. pp. 341-366.
- (6) J. B. HUTCHINSON. (1931.) The possible explanation of the apparently irregular inheritance of polydactyly in poultry. *American Naturalist*, lxxv. pp. 376-379.
- (7) C. J. BOND. (1920.) On the left-sided incidence of the supernumerary digit in heterodactylous fowls. *Journal of Genetics*, x. pp. 87-91.

Col. C. J. BOND drew attention to the higher incidence of the extra or fifth digit on the left side in asymmetric birds, i.e. birds derived from a cross between a four-toed and a five-toed breed of fowls, such as Gallus Bank $\times$ Silky or Houdan $\times$ Andalusian. Out of a total of 225 asymmetric birds, the fifth toe appeared on the left leg in 166 and on the right leg in 59.

The same higher incidence on the left side is also seen in asymmetric spur development. Asymmetric spur growth has so far been observed only in female fowls. In a few old hens, a double spur has been found on one leg. Hackisuka (Tokyo) reports a double spur on one leg in a Japanese Pheasant. It has also occurred in an old Leghorn hen (C. J. B.).

Hemilateral asymmetry of colour-pattern also occurs in fowls. Six or seven cases of 'Mosaic' fowls have been described. Professor F. A. Crew has described two cases. A fowl showing barred rock feather colour with clean shank on the right side, and Brahma feather colour and feathered shank on the left, has been recorded—see 'The Journal of Heredity', January 1935. In Bond's Mosaic or Gynandromorphic Pheasant, the feather colour-pattern was mostly male on the left side with a spur on the left leg, and mostly female with an absence of spur on the right side. Cases of hemilateral asymmetry in animals and man have been recorded, and their significance discussed in my Withering Lecture 'On the Genetic Significance of Hemilateral Asymmetry in the Vertebrate Organism', University of Birmingham, 1932 (Lewis and Co., London).

The bearing of hemilateral asymmetry of digit development in birds on Dr. Fisher's theory of dominance was discussed. The fact that the extra digit character is found in heterozygotes, and not, as far as is known, in homozygotes derived from cross-breeding between a five-toed and a four-toed breed in fowls, was regarded as a suggestive fact.

Attention was drawn to the extension of the influence of the factor controlling the newly introduced (or fifth toe character) to other parts of the organism in some birds. Examples were recorded in which this influence had affected the growth of the three normal forward pointing toes. In some cases

these are stunted in growth and clawless, while in others extra claws may appear on the sides or terminal phalanges of such toes. Further, the condition of unstable genetic equilibrium so induced may extend to the fore-limbs or wings, where in some cases extra claws have appeared on the second digit, as well as the pollux, while in others double claws were present.

As a result of selective breeding among asymmetric birds, individual birds have been bred, with as many as four extra digits, making, with the three normal forward-pointing toes, seven digits on each leg. These extra digits, from three to seven, may be either symmetrically or asymmetrically disposed.

The appearance of a hind limb with six or seven digits and a fore-limb or wing with extra claws represents a type of organism which has diverged from the original five-toed limb of the evolutionary lizard type of Avian ancestor.

The contribution to the discussion was illustrated by lantern-slides.

Prof. E. W. MACBRIDE congratulated Dr. Fisher on the completion of a very valuable piece of work. He was much gratified to hear that Dr. Fisher's point of view had moved much nearer to his own since the old days when they had had acrimonious discussions in the Eugenic Society. Both Dr. Fisher and he recognised that whatever mutations might be they had no significance for evolution. But he differed entirely from Dr. Fisher in regarding 'natural selection' as an alternative cause for evolution. Natural selection regarded in that light was not only a truism, but a dishonest truism. Of course, more were born than could survive, but unless those that lived differed from those that died no evolutionary change would be produced by the survival of those that were 'selected'. What the theory of natural selection as an explanation of evolution covertly suggested was that small variations of every conceivable kind and in every conceivable direction were constantly 'turning up'; but for the origin of these all-important factors no cause was suggested except 'chance'.

The curious and interesting mutations described by Dr. Fisher, instead of being ascribed to the action of mysterious 'genes'—and of the making of 'genes' there was no end,—could all be accounted for as results of one 'weakness of growth' of varying strength. In the development of the chick on the third day the amnion was completed, and thereafter on the fourth and fifth days rocking movements were carried out by the embryo. These movements were connected with the secretion of the amniotic fluid, and this fluid distended the amniotic membrane and pushed it away from the embryo

and so left room for the wings and legs to develop. But in a weakened embryo these movements were too feeble: too little fluid was secreted, and in consequence for a shorter or longer time the membrane pressed on the growing rudiments of the limbs. Thus the rudiments could be divided, and when by the tardy secretion of fluid the divided rudiment was released, two toes instead of one would be present. There was every gradation in this pressure, and every conceivable result. Similar amniotic pressure took place in mammals—fingers could be divided and multiplied or suppressed altogether.

In 1894, when Bateson first brought forward the theory that mutations or 'sports' form the raw material of evolution, he was opposed by one of the fathers of evolution, Dr. Alfred Russel Wallace—who pointed out, as Dr. Fisher has done today, that the sports represent 'variations' for which there is no analogue amongst living or extinct species.

Mr. E. B. FORD said that he regarded Prof. Fisher's theory of dominance-modification by selection operating on the gene-complex as of exceptional importance. It was highly satisfactory to have it so clearly demonstrated by the experiments now described on polydactyly in poultry.

As Prof. Fisher has himself pointed out in the past, the mechanism which has been shown effective in the development of dominance would allow progressive changes to take place in the effect of genes. Contrary to Prof. MacBride's contention, the Mendelian system is thus entirely consistent with a process of slow and apparently continuous evolution. This may be illustrated from the mimetic butterflies, where a single pair of genes may act as a switch in controlling two forms of the same species, each showing highly complex, yet divergent, adaptations.

Prof. R. R. GATES said that Professor Fisher had demonstrated the presence of a single factor for polydactyly, with incomplete dominance, in his poultry crosses. In his book on Natural Selection Professor Fisher had done much to revive an interest in its evolutionary bearings; but he (the speaker) was not convinced that Professor Fisher's ingenious theory of change of dominance through the accumulation of modifiers had been made out in poultry, although there were other cases to which it might very well apply. In his own view the great majority of specific differences were non-adaptational, and the bulk of the raw material of evolution, on which natural selection might or might not act, was supplied by gene mutations—but Professor Fisher does not appear to distinguish between adaptational and non-adaptational characters. Probably all were agreed that one of the functions of natural selection was in cutting off the extremes of variation and the numerous

abnormal mutations, and so keeping the species relatively true under uniform conditions of environment.

Professor Fisher believed that dominant or semi-dominant factors were more common in poultry than in any other animal group. But they were also relatively common in Man. Reference had been made to the fact that the recessive form of an abnormality was in some cases more extreme than the dominant form, and this had been used as an argument in favour of the modification of dominance through the accumulation of modifiers. But it is also known that in Man certain abnormalities are dominant in one pedigree and recessive in another, the recessive type being more virulent in some cases. There is no reason to believe that in Man the recessive form had been derived in any way from the dominant form. Both were contemporaneous and independent.

The A and B blood groups in Man furnished an example of two conditions, both dominant to O, which probably arose as mutations from the O condition. They are inherited as Mendelian units and have nothing to do with natural selection, so far as can be determined. A and B are both completely dominant, and there is no indication of variable dominance or of change from an original recessive condition, through the accumulation of modifiers or by any other means.

Professor Fisher suggested that the occurrence of homologous mutations, such as polydactyly, in many different species of birds, indicates that perhaps the whole phylum of birds had inherited the capacity for producing this mutation. But on the theory of parallel mutations it appeared more probable that this capacity may have arisen independently in various groups of birds. Similarly, there is evidence that the B blood group in Man is younger than the A, which alone occurs (crossing excepted) in such primitive races as the Australian aborigines and the South African Bushmen. It appears that the rise and spread of the A and B blood groups can best be explained on the hypothesis that at a certain period a particular human race began to produce the A mutation with a certain frequency. Inheritance, migration, and crossing will then account for its spread in the absence of selection. Similarly, it must be assumed that at a later period the B mutation began to appear and spread from a certain centre of mutation. But there was at present no suggestion as to why at a certain time and place in a particular race a particular mutation should begin to appear.

Another condition in Man which has a bearing on the theory of mutation and change of dominance is that of the White Indians of Darien. Apparently all human races have the capacity of producing occasionally albinotic recessive mutations; but in most races they are relatively rare, while in

this tribe of Indians they have been known from soon after the Columbian discovery to be present in relatively large numbers. One can only suppose that in this tribe at a period dating back at least several centuries albinotic mutations began to appear at a much higher rate, leading to a high frequency of albinos, although such selection as exists, both natural and human, is definitely directed against them.

From such cases one may draw the conclusion that the mutation rates of a particular species can vary from time to time, and the capacity to produce particular mutations is not necessarily as old as the species. Moreover, such mutations can accumulate, even in the face of selection, if the mutation rate is high enough.

Mr. MICHAEL PEASE much regretted that he had been unable to grasp what the exhibition in front of them was supposed to demonstrate. If he had rightly understood Professor Fisher's theory of the evolution of dominance in poultry, it was that in the course of domestication the primitive fancier had continuously selected those birds in which the dominance of the new character was most pronounced; thus there had come about an accumulation in domesticated poultry of modifying factors which strengthened dominance. The crucial experiment, which he had expected to see before them that afternoon, was to compare an F 2 of the hyperdactyly factor working on a background of modifying genes known to contain the dominance modifiers with an F 2 of the same factor working on a background of other factors from which the dominance modifiers were known to be absent. To put it crudely, he had expected to see a 3 : 1 segregation in the one case and a 1 : 2 : 1 segregation in the other. But the demonstration in front of them showed nothing of the sort; it lacked entirely a standard of comparison.

With regard to the Barring Factor, he suggested that the photographs shown that afternoon differed in no material respect whatever from the picture of the Cambar downs published in 'The Journal of Genetics' in 1930. Yet in the Cambar case the dominance modifiers were presumably present, while in the photographs in front of them the dominance modifiers were, *ex hypothesi*, absent. The case of the Cambar was perfectly straightforward—the determining factor was the presence or absence of the well-known dominant Black Extension gene. Indeed, in Professor Fisher's photographs before them, it was obvious that in the darker chicks the distinction between the homozygote and the heterozygote was less clear than in the paler chicks.

It was not sufficient to accept unreservedly the text-book statements as to dominance, as indeed Professor Fisher had himself pointed out. For ordinary purposes it might be

sufficient to say that a character was dominant; but it did not necessarily follow that dominance was always 'perfect'. There were not many dominant genes in poultry for which it could be said with confidence that the homozygote could not be distinguished from the heterozygote in every circumstance and at every stage of the bird's growth. For example, in the Barred Rock, the two classes of barred chicks were indistinguishable at hatching, but quite sharply distinct at a few weeks old. Clearly, then, if they were going to experiment with factors modifying dominance, it became necessary to qualify, to state precisely the relevant conditions, and to have an accurate standard of comparison. It was for these reasons that he thought the demonstration in front of them failed to convince.

Dr. SANSOME also spoke.

In a reply communicated in writing after the meeting, Professor FISHER said that:—

The work of Dr. Bond on the incidence of asymmetrical polydactyly had always appeared to him of the greatest interest, as showing the effectiveness even of minor and unexpected environmental influences on the manifestation of mutational effects. The fact of importance here was that the mutant form, even when homozygous, was often so much more variable than the wild form. This applied equally to genetic and to environmental causes of variation. This fact could, on the views as to modifying factors which he had put forward, be explained by the wild form having been exposed in large numbers of individuals and over very long periods of time, and therefore in an enormous variety of contingent circumstances, both environmental and genetic, to the stabilizing influence of natural selection. The lability of the mutant forms, on the other hand, was admirably illustrated by the rapidity with which Dr. Bond had been able to enhance the manifestation of the polydactyl gene until it produced no less than three new toes.

The comprehensiveness of this principle, especially in its bearing on polymorphic species and the remarkable dominance relationships shown by these, had been most effectively stated by Mr. Ford, to whose writings the speaker was indebted for many of the phrases used in his lecture and for the terms in which the new ideas could be best explained.

In reply to Professor Gates, the speaker said that the most readily demonstrable changes in dominance among the factors he had studied in poultry, were those of Crest, where the modification had been principally due to the suppression of hernia in homozygotes of the Silky breed and of Feathered feet, where, even among the Silkies, in which the feathering

was by no means extravagantly developed, the heterozygous manifestation had been very greatly enhanced. He had no doubt, from the records of experiments with polydactyly, that here also dominance differed greatly in different breeds.

He did not accept the dogma that the majority of specific differences were non-adaptational, but thought, on the contrary, that differences of generic or ordinal value must have been built up by a continuation of the same process by which specific differences were produced. The adaptive character of these larger differences was universally recognized, and he inferred it was largely due to our ignorance of the ecology and life-history of natural populations that we were often, though not always, unable to demonstrate the adaptive significance of specific differences.

It was the point of his work that the domestic fowl was not really exceptional, as had often been thought, in the occurrence of dominant factors; and he believed that Man also was by no means exceptional. It was immensely easier to detect non-recessive than recessive abnormalities in human pedigrees, but there was scarcely ever evidence of real dominance, or even to show that the homozygous mutant would be viable if produced. The isoagglutinogens, A and B, showed no mutual dominance, though they might be said to be dominant to O. It should be remarked that this was true only so long as no serum had been prepared specific for the gene O, an object which might at any time be achieved. In that case O would fall into line with the other known agglutinogens, such as M and N.

In reply to Mr. Pease, he would like to say that the particular purpose and method of the experiment had been in print, and personally known to Mr. Pease, from its inception six years before. Until the result of the tests was known he had not suggested that the comparison was in the least unsatisfactory. The direct aim of the experiment was simply to ascertain whether, in a strain of wild jungle-fowl, the so-called dominants in poultry were dominant or not. If it appeared, as it already clearly appeared in some cases, that there was no dominance, several further interesting questions arose as to why such factors had been regarded as dominant in breed-crosses. These questions could not be answered by an experiment confined to the wild strain without further information from other sources. For example, it was now evident that the gene for crest had been regarded as dominant largely because its characteristic recessive effect of producing cerebral hernia had been suppressed, by conscious or unconscious selection, in the Silky breed. With respect to the

'barred' mutation, with its nearly recessive effects on the down plumage, he would agree that the change towards dominance, probably always incomplete in the adult, had been brought about by the black extension factor, and if this were later shown to be the whole story the case might well be regarded as typical of the ways in which dominance might be modified. He saw no reason to suppose that the modifier ought to be present in the Cambar, since it was apparently lacking in the Campine.

In reply to Dr. Sansome, the speaker thought he would be the last person in the world who would be willing to dogmatize as to the processes by which modifying factors, or other Mendelian factors, brought about their effects. That phase of the matter seemed to him at present in a stage that was interesting, and perhaps valuable, to discuss in a spirit of conjecture, but was not yet on the same scientific level as the conclusions which could be drawn directly from demonstrable genetic facts.

21 MARCH 1935

Dr. W. T. CALMAN, F.R.S., President.
in the Chair

The Proceedings of the General Meeting held on Thursday, 7 March 1935, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted:—Lt.-Col. Charles Hervey Grey, D.S.O., May Sherwood Campbell, Douglas Stewart Raitt and Richard Holliday Pott.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time, in favour of John Milton Offord and Florence Hannah Bacon Marsh; for the first time, in favour of Ruby Elaine Dowling, Samuel Edward Wilson and Wilfred Ernest Watson Baker.

The President reported the death of Robert Paulson, F.L.S.

The President read the following proposed alterations to the Bye-Laws:—

CHAPTER II, SECT. II, *add the following* :—

....; and provided, moreover, that any Fellow not in arrears with his Annual Contribution may at any time compound for all future Annual Contributions by a single Payment according to the Table set out in the Appendix. Every Fellow desiring to compound must satisfy the Council as to his age.

CHAPTER II, SECT. IV, *after the word Admission add either compound or.*

APPENDIX

Scale of Composition Fees

AGE (last birthday).	COMPOSITION £	AGE (last birthday).	COMPOSITION £
21	88	46	68
22	87	47	67
23	86	48	66
24	86	49	64
25	85	50	63
26	84	51	62
27	84	52	61
28	83	53	60
29	82	54	58
30	82	55	57
31	81	56	56
32	80	57	54
33	79	58	53
34	78	59	52
35	78	60	50
36	77	61	49
37	76	62	48
38	75	63	46
39	74	64	45
40	73	65	43
41	72	66	42
42	72	67	40
43	71	68	39
44	70	69	37
45	69	70	36

There shall be deducted from the amount of the Composition a sum equal to one per cent thereof for every Annual Contribution above ten paid by the Fellow compounding.

'Symbiosis' between Invertebrates and unicellular Algae.

By Prof. C. M. YONGE (Visitor).

THE intimate association between invertebrates and green or brown unicellular algae is of widespread occurrence, as Buchner (1930) has shown in his exhaustive summary of the literature. Often loosely described as 'symbiosis', the nature of the association, where this has been studied experimentally (to which cases attention is here confined), has been shown to differ widely.

Origin of the association.

As shown elsewhere (Yonge, 1934) association with algae is, with a few anomalous exceptions probably capable of explanation, confined to invertebrates which digest intracellularly. The algae were probably first acquired in this way, and they are certainly always contained within the tissue-cells of the animals*.

The establishment of a permanent association must differ according to whether the animals are herbivores (Protozoa, Porifera) or carnivores (Coelenterata, Ctenophora, Turbellaria, and such Opisthobranchs as possess algae). The possible development of the association, so far as this is indicated by available evidence, is indicated below:—

I. HERBIVORES.—The establishment of an association involves specialization of the algae to resist digestion.

1. Spongillidae (Van Trigt, 1919).—The life of the algae (*Pleurococcus*) in the amoebocytes of the sponge is prolonged; they are capable of resisting digestion temporarily.

2. *Paramecium bursaria* (Pringsheim, 1928).—Though the animal normally feeds on yeasts, algae and bacteria, the associated *Chlorella* are only digested under extreme conditions of starvation. In light an autotrophic condition is established if suitable quantities of nutrient salts and of calcium are present in the water.

II. CARNIVORES.—Though normally such animals refuse to ingest vegetable matter, under conditions of enfeeblement algae can apparently enter the cells of the endoderm, the first stage in the association being a form of parasitism by the plant. The establishment of a permanent association involves specialization of the animal: (a) to tolerate the presence of algae; and (b) sometimes to feed upon them. Goetsch (1924), in his work on

* Brock (1888) stated that the zooxanthellae in *Tridacna* do not occur intracellularly, but I find the direct opposite (Yonge, 1935). In the purely parasitic infection by *Chlorella* of *Anodon* (Goetsch and Scheuring, 1926) and *Limnæa* (Boycott, 1926) the algae occur between the cells. In the compound Ascidians (Smith, 1935) zooxanthellae occur in the common test and not in the tissues.

the Hydrida, has thrown valuable light on the establishment of the association here.

1. *Pelmatohydra oligactis* and *Hydra circumcincta*.—Never contain algae and cannot be artificially infected.
2. *Hydra vulgaris*.—Spontaneous infection occasionally occurs and can be brought about artificially and maintained temporarily.
3. *Hydra attenuata*.—Artificial infection with *Chlorella* is easier and the algae spread further through the tissues and become increasingly difficult to dislodge. As in *H. vulgaris* infection is preceded by enfeeblement of the animals and accompanied by pathological symptoms. Finally, according to Goetsch, the presence of the algae may so affect the tissues as to form a new race, *H. viridescens*, where the association may be regarded as a true symbiosis.
4. *Chlorohydra viridissima* (Goetsch, 1924, Haffner, 1925) and the Turbellarian *Dalyellia viridis* (Haffner, 1925).—In these animals a balanced condition has become established, the *Chlorella*, which are very difficult to dislodge, being transmitted *via* the egg.

Further development after the establishment of the balanced relationship exemplified by (4), where *both* members are capable of independent existence, may take place in one of two directions: (A) the animal may become dependent on the plant, and (B) the plant may become dependent on life in the animal:—

- A. This condition is best exemplified by *Convoluta roscoffensis* (Keeble & Gamble, 1907; Keeble, 1908, 1910), where the animal, after an initial holozoic existence, ceases to feed and becomes parasitic on the contained *Carteria*. An intermediate link between this condition and that in *Dalyellia* or *Chlorohydra* is provided by *Convoluta paradoxa*.
- B. In the Anthozoa, as shown by the work of Yonge and Nicholls (1931 a, 1931 b) on Madreporaria and of Smith (see pp. 97–100) on the Actinian *Anemonia sulcata*, the animals are capable of existence when deprived of the contained zooxanthellae, but the latter *never* exist free in the sea as do the algae present in *Convoluta*. They are transmitted by way of the planulae.

There are also certain cases where one animal has probably been infected by an alga already specialized for life in another:—

1. *Aeolidiella alderi* (Naville, 1926).—This Nudibranch feeds exclusively on the Actinian *Heliactis bellis*, from which it acquires not only nematocysts, but also zooxanthellae. Other Opisthobranchs which contain algae may have been similarly infected.
2. Compound Ascidians.—Certain tropical species contain within the common test zooxanthellae in every way similar to those of Anthozoa (Smith, 1935).
3. Tridacnidae.—This is the only family of the Lamellibranchs to possess zooxanthellae which are similar to, but not identical with, those of the Anthozoa (Yonge, 1935). Since, like all Lamellibranchs with the exception of the Septibranchs, the Tridacnidae are specialized herbivores, it is not improbable that the zooxanthellae were already specialized for life within animal tissues before being acquired.

Modifications resulting from 'Symbiosis'.

Both animals and plants may be modified, both structurally and physiologically, as a result of their association. This may effect either the individual or the race:—

1. *Algae*.—Structural changes affecting the individual are exemplified by the smaller pyrenoids in the *Chlorella* in *Chlorohydra* (Haffner, 1925) when it feeds saprophytically, as it can, in darkness, and also by the difference between the free-living *Carteria* and those present in *Convoluta roscoffensis*. Physiological changes are exemplified by the power of saprophytic nutrition acquired by the *Chlorella* in *Chlorohydra* and in *Paramecium bursaria* (Pringsheim, 1928).

The zooxanthellae present in the Anthozoa, certain Scyphozoa and Hydrozoa, the Tridacnidae and the compound Ascidians are examples of algae in which the race is affected. They have lost the capacity for free existence and for sexual reproduction, and, except in the Tridacnidae, have acquired a very thick cellulose wall.

2. *Animals*.—The change from *Hydra attenuata* to *H. viridescens* as a result of algal infection, as held by Goetsch (1924), is the only example of change in the individual. Structural and physiological changes affecting the race are well exemplified by conditions in *Convoluta roscoffensis* and *C. paradoxa* and in the Tridacnidae.

In both species of *Convoluta* excretory organs are absent, while their omnivorous habit (during the holozoic stage in *C. roscoffensis*), unlike the purely carnivorous habit of the remaining Turbellaria, may well be the result of their association with algae. The habits of these animals, notably *C. roscoffensis* (Gamble & Keeble, 1903), are clearly correlated with the possession of algae. Finally, in *C. roscoffensis* there is the eventual loss of the power of holozoic nutrition (Keeble & Gamble, 1907; Keeble, 1908, 1910).

In the Tridacnidae, especially in the genus *Tridacna*, profound structural changes have taken place (Yonge, 1935). The mantle (and so the shell) has twisted around so that the free edges are dorsal instead of ventral. In this way the zooxanthellae contained in blood-cells within them are fully exposed to the light. In *Tridacna* the mantle edges are extended and project over the margins of the shell-valves, while groups of clear cells (described as 'eyes' by Vaillant (1865) and Brock (1888)) increase the internal illumination of the mantle tissues. These animals literally 'farm' the algae. There is also some modification in the structure of the alimentary system.

Significance of the association.

The most debatable point about the association is its significance. This unquestionably varies in different cases. The matter can most suitably be discussed in terms first of the algae and second of the animals:—

1. *Algae*.—These obtain protection, temporarily or permanently according to whether or no they are eventually digested. More important, they obtain food. There is abundant carbon dioxide, but this is of minor significance because it is normally available. The important factor is the supply of nitrogen

(as nitrate or ammonia) and of phosphorus (as phosphate) which are the limiting factors in plant-life. Plants which by living within animal tissues are able to tap supplies at the source have solved the problem of nitrogen and phosphorus 'hunger'. Pütter (1911) has shown that the zooxanthellae in the Actinian *Aiptasia* can utilize ammonia, and Yonge and Nicholls (1931 a) and Yonge (1935) that the zooxanthellae of corals and of *Tridacna* can intercept the phosphate which would otherwise be excreted by the animals.

The algae may obtain food saprophytically. The algae in *Convoluta* can utilize uric acid and urates (Keeble & Gamble, 1907; Keeble, 1908). The *Chlorella* which live in *Paramecium bursaria* (Pringsheim, 1928) and in *Chlorohydra* (Haffner, 1925) are both capable of surviving and actually increasing in the dark if the animals are well fed, which indicates that they must be feeding saprophytically.

2. *Animals*.—The oxygen produced by the algae in the light is of dubious advantage to the animal. It is true, as a number of workers have shown, that a 'green' animal will live longer in deoxygenated water than will a 'colourless' one of the same species, but such conditions are seldom likely to occur in nature. Van Trigt (1919) thinks that oxygen production by the *Pleurococcus* may be of significant value to the green Spongillidae. Verwey (1930, 1931) considers that the mass of animal matter represented by a living coral reef could not exist without the oxygen produced by the contained zooxanthellae, but this view is opposed by Yonge, Yonge and Nicholls (1932).

There is good evidence that the algae assist in the nutrition of some, though not all, animals which possess them. Organic matter may be passed from the living algae to the tissues of the animal. This occurs (Pringsheim) in *Paramecium bursaria* in the autotrophic condition; Goetsch, though not Haffner, believes it occurs in *Chlorohydra*. In *Convoluta roscoffensis* (Keeble & Gamble) it occurs in the early stages and throughout life in *C. paradoxa* (Keeble, 1908). It should be noted that this transference of material implies an excessive production by the plant, due either to its small numbers in comparison with the bulk of the animal or else to the high metabolism of the latter. This is not true of the zooxanthellae of corals (Yonge & Nicholls, 1931 a; Yonge, 1931), which will take additional phosphorus from the surrounding sea-water.

The animal may digest algae which have died in the tissues. This, according to Haffner, is what occurs in *Chlorohydra* and *Dalyellia*.

In other cases the algae are killed and digested by the animal. This occurs normally in the Spongillidae (Van Trigt), in *Convoluta roscoffensis* in the latter stages of the existence of the individual (Keeble & Gamble), and in the Tridacnidae (Yonge, 1935). It also occurs, but only in extreme starvation, in *Paramecium bursaria* (Pringsheim) and in *Convoluta paradoxa* (Keeble, 1908).

The zooxanthellae present in the corals and other Anthozoa, and probably in the Scyphozoa and Hydrozoa, are not digested (Yonge & Nicholls, 1931 b; Yonge, 1931), the opposite opinions of various authors culminating in those of Boschma (1924, 1925 a, b, c, 1926) being due to erroneous interpretation of observations, notably the presence of degenerating algae in the 'absorptive' zone of the mesenterial filaments, which is actually also 'excretory'. Starvation of corals leads to the expulsion of algae and their consequent appearance in great

numbers in the mesenterial filaments, but this is due to the lowered metabolism of the corals, the same effect being produced by exposure to high temperature or to water of low oxygen tension (Yonge & Nicholls, 1931 *a*).

As indicated above the algae automatically remove the excretory products of the animals, carbon dioxide, nitrogenous compounds and phosphates. The significance of this is indicated by the absence of excretory organs in *C. roscoffensis* and *C. paradoxa*. The importance of this factor is more difficult to assess in the Protozoa, Porifera and Coelenterata, which possess no specialized organs of excretion, but it is probably very important. As indicated elsewhere (Yonge, 1931) the association between corals and zooxanthellae, essential to the plants but not to individual coral colonies, is probably an indispensable factor, by the automatic removal of the waste products of metabolism, in the necessarily exceptional powers of growth and repair possessed by the communities known as coral reefs.

General conclusions.

A balanced association (i.e. true symbiosis) is clearly of great advantage, because in this way an almost *closed system* is established requiring the minimum supply of energy from outside sources. For instance, it was found (Yonge, Yonge & Nicholls, 1932) that out of twenty-two reef corals containing zooxanthellae which were confined in sealed glass jars and placed in the sea all but five were alive after fourteen days. The best example of all is probably the autotrophic existence of green *Paramecium bursaria* in the dark (Pringsheim). There is an abbreviation of the normal chain of events, so that the zooxanthellae within corals can adequately be described as 'imprisoned phytoplankton' (Yonge, 1931). Under such conditions a true symbiosis is developed, the plant taking food in the form of carbon dioxide and other waste products of metabolism from the animal, and the animal gaining in efficiency as a result of the automatic removal of these and possibly, though improbably, by the additional supply of oxygen. There may also be a passage of organic matter from the plant to the animal where the plant is in a position to produce more than it requires, and also, where the plant has acquired the power of saprophytic nutrition, from the animal to the plant. *Paramecium bursaria*, *Chlorohydra* and the Coelenterates which contain zooxanthellae are all instances of what is probably a true symbiosis, though it should be remembered that in the last named the zooxanthellae are incapable of independent existence.

But the association cannot be described as symbiosis if one party exploits the other. Actually the algae never exploit the animals except in what is probably the early stages of the establishment of an association, when, as described by Goetsch, they become parasitic in enfeebled

individuals. Unless a balanced condition is reached parasitism by the plant will end in its own destruction as well as in that of the animal.

The animal is, however, in a position to exploit the plants. It does so to the final destruction of the individual, though not of the race, in *Convoluta roscoffensis*, and without the destruction of the individual in the Tridacnidae, and to a less extent in *Convoluta paradoxa* and the Spongillidae. Destruction of the individual is avoided because the animals never cease to feed holozoically and so to obtain energy from outside sources. It is necessary for the full exploitation of the algae for the animal to be able to maintain the algae alive in the tissues (a process which involves the specialization of the algae in herbivorous animals) and then, by some process which is not clear, to digest them as required (this requires specialization of the animal in carnivores). *Tridacna*, which had developed 'farming' of the algae to a greater extent than *Hippopus*, the other genus of the Tridacnidae, is the supreme example of exploitation of associated algae by animals.

REFERENCES.

- BOSCHMA, H. 1924. Proc. Acad. Sci. Amst. xxvii. 13.
 — 1925 a. Proc. Nat. Acad. Sci. Wash. xi. 65.
 — 1925 b. Proc. Amer. Acad. Arts Sci. lx. 451.
 — 1925 c. Biol. Bull. Woods Hole, xlix. 407.
 BOYCOTT, A. E. 1926. North Western Naturalist, i. 10.
 BROCK, J. 1888. Z. wiss. Zool. xlv. 270.
 BUCHNER, P. 1930. 'Tier und Pflanze in Symbiose', Berlin.
 GAMBLE, F. W., & KEEBLE, F. 1903. Quart. J. Micr. Sci. lvii. 363.
 GOETSCH, W. 1924. Z. Morph. Ökol. Tiere, i. 660.
 GOETSCH, W., & SCHEURING, L. 1926. Z. Morph. Ökol. Tiere, vii. 221.
 HAFFNER, K. v. 1925. Z. wiss. Zool. cxxvi. 1.
 KEEBLE, F. 1908. Quart. J. Micr. Sci. lii. 431.
 — 1910. 'Plant-animals'. Cambridge.
 KEEBLE, F., & GAMBLE, F. W. 1907. Quart. J. Micr. Sci. li. 167.
 NAVILLE, A. 1926. Rev. Suisse Zool. xxxiii. 251.
 PRINGSHEIM, E. G. 1928. Arch. Protistenk. lxiv. 289.
 PÜTTER, A. 1911. Z. allg. Physiol. xii. 297.
 SMITH, H. G. 1935. Ann. Mag. Nat. Hist. (10) xv. 615.
 TRIGT, H. VAN. 1919. Tijdschr. Nederl. dierk. Vereenig. 2nd ser. xvii. 1.
 VAILLANT, L. 1865. Ann. Sci. Nat. 5th ser. iv. 71.
 VERWEY, J. 1930. Proc. 4th Pacific Sci. Cong. Batavia, ii A, 271.
 — 1931. 'Treubia', xiii. 169.
 YONGE, C. M. 1931. 'Nature', cxxviii. 309.
 — 1934. 'Nature', cxxxiv. 12.
 — 1935. Sci. Rpts. G. Barrier Reef Exped., Brit. Mus. (Nat. Hist.). i. no. 11 (in the press).
 YONGE, C. M., & NICHOLLS, A. G. 1931 a. *Ibid.* i. 135.
 — 1931 b. *Ibid.* i. 177.
 YONGE, C. M., YONGE, M. J., & NICHOLLS, A. G. 1932. *Ibid.* i. 213.

Prof. F. E. FRITSCH congratulated Prof. Yonge on the interest of his communication. A most significant feature of the association of algae and animals was the small number of genera of algae involved, viz., *Chlorella*, *Coccomyxa* in certain Echinoderms, *Carteria* in *Convoluta*, and the zooxanthellae. Since the number of unicellular algae was legion this meant that, if there were wholesale ingestion, only a minority could escape digestion and establish themselves in the tissues of the animal. There was one point made by Prof. Yonge that he could not understand. He had emphasized that in the Anthozoa the alga was dependent on the animal, and had stated that the former could not lead an independent existence. But if, as he believed was the case, only certain individuals were occupied by the alga, this must mean that the latter obtained ingress from outside, and therefore that it existed in the environment. He moreover recalled observations of Brandt's on the zooxanthellae in Radiolaria, in which swarming stages of the alga were recorded, and this implied a free-living existence. Prof. Yonge had referred to modification of the alga within the animal, and had cited as an instance the presence of smaller pyrenoids than usual in the chloroplasts of *Chlorella*. He would, however, merely regard this as indicating that the alga was storing little reserve-food, probably because it was parting with some of its excess to the animal. He would in any case doubt the advisability of comparing the *Chlorella* within the animal with any free-living *Chlorella*, unless the material of the latter had been indubitably isolated from the animal in question. It seemed highly probable that the *Chlorellae* inhabiting diverse animals represented distinct physiological races, as had been shown by Chodat to be the case for the gonidia (*Trebouxia*) found in lichens.

Dr. H. BOSCHMA (Visitor) stated that he had a great admiration for the work done by Dr. Yonge. He wanted to draw attention to two or three points in which he had not been convinced by Dr. Yonge's statements.

Sections in which zooxanthellae are found lying in the immediate neighbourhood of entoderm cells, or even are found partially projecting from the cells, do not prove that these cells are excreted from the tissues: the algae may as well be on their way to the interior of the cells to be digested there.

It is difficult to explain how zooxanthellae, whether single or in groups, occur in all parts of the canal system of the polyps unless by assuming that they are extruded from the neighbouring entoderm cells. So, e.g., in the canal system in the coenosteum of *Pocillopora* these algae may repeatedly

be found. According to Dr. Yonge's opinion these cells must have been extruded from the mesenterial filaments, and must have gone a comparatively long way before they arrived at the spots where they are found in the sections.

In a coral polyp or another anthozoan which contains zooxanthellae in its entoderm the mesenterial filaments usually show a great number of these algae in a disintegrated state (Yonge's explanation is that these algae are excreted from the mesenterial filaments; according to Boschma they are digested here). When such an anthozoan is repeatedly and abundantly fed with animal matter the zooxanthellae gradually disappear from the mesenterial filaments (according to Yonge because the improvement in the animal's condition makes it possible for many more algae to remain in the entoderm than in normal circumstances; according to Boschma because no algae are ingested in the mesenterial filaments as sufficient other food is available). Dr. Boschma suggested an experiment which in all probability would be a crucial test. When an anthozoan with zooxanthellae in its entoderm is abundantly fed with animal matter for a very long time one of two things must happen. If after this time the mesenterial filaments again contain algae in a disintegrated state notwithstanding the abundant animal food, then they have come there because they are being excreted. If, on the other hand, abundant and repeated feeding with animal matter causes the mesenterial filaments to remain devoid of algae, then excretion of the algae does not necessarily take place in the mesenterial filaments only, and the disintegration of the zooxanthellae in the mesenterial filaments is probably due to digestion by the polyp. In conducting this experiment an important decision might be reached with simple methods.

Mr. H. G. SMITH stated that unicellular algae occur in certain Actiniaria, and the first important experimental work on the nature of the association was that of Brandt (1883). Anemones were starved in light and in darkness, and from the results of these experiments Brandt concluded that the animals obtained nutriment from the zooxanthellae when deprived of animal food. Later work by Boschma (1926) on *Cribina xanthogrammica* supports Brandt's view. Brandt was unable to observe the digestion of the zooxanthellae, and assumed that food material was passed in soluble form from alga to animal. By studying the mesenterial filaments of *C. xanthogrammica* Boschma brought forward evidence in favour of the view that the zooxanthellae are actually digested by the anemone. In his opinion such actinians live partly on the zooxanthellae and partly on animal matter, and in starvation they depend chiefly on the algae.

In the Madreporaria, where the algae are more widely distributed than in the Actiniaria, and in which the conditions appear to be identical, there has been a considerable controversy about the exact nature of the association. This has been reviewed at length by Yonge and Nicholls (1931 *b*). The view that the zooxanthellae are a source of food to the corals is upheld by Boschma (1926) but entirely opposed by Yonge and Nicholls. The latter believe that the presence of the zooxanthellae in the 'absorptive' zone of the mesenterial filaments, which certainly occurs when the corals are starved, is due to the *rejection* and not the digestion of the algae. Yonge (1931 *a*) has shown that the 'absorptive' zone of the mesenterial filaments is also the excretory zone, the zooxanthellae, which are always contained within tissue cells, being carried there when the metabolism of the coral is lowered. In view of these results it seemed desirable to reinvestigate the conditions in the Actiniaria, particularly because Mouchet (1930) has shown that in these animals the 'absorptive' zone of the mesenterial filaments is also the excretory zone.

Both brown and green varieties of the algal-containing anemone *Anemonia sulcata* were used for this work, together with *Actinia equina* which does not contain algae. The zooxanthellae of *Anemonia* are similar in structure to those of the Madreporaria described by Yonge and Nicholls (1931 *a*). They are yellowish brown spherical bodies varying in diameter from 7–12 μ . In the living cell one or two assimilation products can be seen, while in stained preparations a granular nucleus, one or two pyrenoids with assimilation products, and a vacuolated cytoplasm with numerous oil drops can be determined. The whole cell is bounded by a thick wall which gives positive reactions when tested for cellulose. The distribution of the algae in the tissues agrees with that of corals, being confined to the cells of the endoderm.

The following experiments were made on the effect of starvation on the anemones in light and in darkness:—

Experiment 1.—*Starved in light.*

A glass tank of capacity nine gallons was used and eight brown and green specimens of *A. sulcata* with eight *A. equina*, as controls, were placed in it with twenty litres of fresh, filtered sea-water. The water was kept well aerated and changed every four weeks. Great care was taken throughout this experiment and the second one to keep the water and the tanks clean. The experiment was carried on for thirty-two weeks, after which the animals were fixed. No deaths occurred, and all the *Anemonia*, though paler owing to the loss of the algae and considerably smaller, were in a very healthy condition.

Experiment 2.—*Starved in light and in darkness.*

For the second experiment four tanks, each provided with a glass top and of a capacity of nine gallons, were arranged in the order A, B, C and D. A and C were clear, while B and D were coated with black enamel several times and, in addition, were completely covered with black cloth to make them light-tight. Air was supplied by a small pump worked by an electric motor. A siphoning system was set up and the water circulated through the four tanks from A to B, B to C, C to D and D to A. In each tank were placed two *A. sulcata* and two *A. equina*. The water was changed every three weeks, and at the end of the first three weeks of the experiment the *Anemonia* in darkness were distinctly paler than those in light. After nine weeks the animals were still healthy, but in the darkened tanks the *Anemonia* were pure white with the exception of two green specimens which still retained their purple and green pigment. After twenty-five weeks the experiment was stopped and the animals fixed for sectioning. The anemones had been starved for twenty-five weeks in light and in darkness, and were very healthy at the end of the experiment. Those in the clear tanks were pale in colour, while those in darkness were snow-white with the exception of the green specimens. Microscopical examination of sections showed that the algae in the *Anemonia* from A and C were few compared with a normal specimen, while in the anemones starved in darkness, i.e. in B and D, zooxanthellae were absent.

It is evident from the first experiment that the starving of *Anemonia sulcata* in light, by lowering the metabolism of the anemone, disturbs the metabolic balance both of the animal and the plant, and the number of zooxanthellae is reduced until some sort of equilibrium is reached, exactly as postulated by Yonge and Nicholls for the *Madreporaria*. Masses of algae are ejected from time to time to maintain this equilibrium. The ejected algae are apparently quite healthy, and it is difficult to understand the reason for their ejection if they have as much food value as Brandt implies.

When the anemones are starved in darkness the zooxanthellae are deprived of carbohydrates as well as nitrogen and phosphorus, and are vigorously ejected by the animals. In a specimen examined after five weeks there were a few healthy algae in the tissues, but eventually, after two months, all the algae had died and had been ejected. The *Anemonia* were kept in a healthy condition for twenty-five weeks, and as they lived for sixteen weeks without zooxanthellae there can be no doubt that the anemones are capable of living quite well in their absence.

From these investigations it has been found impossible to agree with Brandt's statement that algal-containing anemones obtain nutriment from their zooxanthellae when deprived of animal food. The association, as in corals, is essential for the zooxanthellae, but *not* for the animals. Though the need for algae is less obvious than in the Madreporaria—Yonge (1931 *b*) having pointed out their probable significance in the life of coral reefs as *communities*, though not as individuals—there is no reason to doubt that they also subserve the function of excretory organs in facilitating the removal of the waste products of metabolism from the body of the anemone.

REFERENCES.

- BOSCHMA, H. 1926. Proc. Acad. Sci. Amsterdam, xxxi. 993-997.
BRANDT, K. 1883. Mitt. Zool. Stat. Neapel, iv. 257-265.
MOUCHET, S. 1930. Stat. Ocean. Salammô, Notes no. 15, pp. 1-15.
YONGE, C. M. 1931 *a*. Sci. Rept. G. Barrier Reef Exped. 1928-29, Brit. Mus. (Nat. Hist.) i. 83-91.
—— 1931 *b*. 'Nature', cxxviii. 309.
YONGE, C. M., & NICHOLLS, A. G. 1931 *a*. Sci. Rept. G. Barrier Reef Exped. 1928-29, Brit. Mus. (Nat. Hist.), i. 135-176.
—— 1931 *b*. Sci. Rept. G. Barrier Reef Exped. 1928-29, Brit. Mus. (Nat. Hist.) i. 177-211.

Mr. A. D. COTTON referred to the association of larger algae (i.e. not unicellular) with sponges. These were found amongst the Cyanophyceae, Chlorophyceae and Florideae, and varied from casual infection to more intimate associations, some of which were symbiotic. The latter are more frequent in tropical waters. He referred particularly to the association of the tropical red seaweeds *Thamnoclonium Tissotii* and *Ceratomyon spongiosum* with sponges. In the former the general form of the dual organism is determined by the alga, in the latter probably mainly by the sponge. The former consists of a large flattened thallus of parenchymatous structure. Both surfaces are clothed with a thin sponge, into which penetrate specialized moniliform filaments given off from the outer layer of algal frond. In the latter species the main segments of the thallus are composed of slender multicellular branches, which are woven together to form a dense network, the interstices being filled up by the sponge which forms an investing coat around each segment. The significance of the oxygen liberated during photosynthesis was commented on.

Dr. G. P. BIDDER could not quite accept Prof. Yonge's statement that unicellular algae found in sponges are invariably intracellular. Red algae free in the mesogloea of *Clathrina* were found by Urban at Naples, and similar bodies are described by Dendy in *Clathrina* from Chagos Archipelago.

References will be found in Journ. Linn. Soc. xxxiv. p. 307 *et seqq.*, together with Bidder's observations on *Syncrypta* spheres in a similar position in *Clathrina* at Naples. *Ephydatia* in Wicken Fen is densely inhabited by diatoms; most, but not all, of these are imbedded in spongin, and so completely cut off from contact with the living tissue; some are free in the jelly. ('Wicken Fen', Pt. vi, 1932, p. 642.)

Sir FREDERICK W. KEEBLE also spoke.

Prof. YONGE, in reply to Prof. Fritsch, stated that the zooxanthellae contained in corals and similar Anthozoa are carried from generation to generation by way of the planulae. Great numbers of water samples were taken throughout the year while working in Australia, but zooxanthellae were never found in the phytoplankton. The brown algae contained in the Radiolaria, where sexual stages have been observed, are probably quite distinct from the zooxanthellae contained in corals. The conditions of association between algae and Radiolaria would well repay further study in the light of recent work. The small pyrenoids of chlorellae contained in *Chlorohydra* have been recorded by various workers. This is really a problem for botanists to investigate.

Keen appreciation of Professor Boschma's remarks was expressed, notably his proposal that a crucial experiment should be conducted, the results of which would indicate whether or no corals and actinians could obtain nutriment from the zooxanthellae. This experiment, it was promised, should be carried out.

Reference was made to comments on the possible significance of the oxygen produced by the algae in the life of the animal. This is difficult to assess, but was probably seldom (though not necessarily always) of minor importance. If zooxanthellae were not present in corals there would be a corresponding increase in the phytoplankton around the corals, and oxygen would be formed by this.

The PRESIDENT conveyed the thanks of the meeting to Prof. Yonge for opening the Discussion, and to the Fellows and Visitors who had made contributions.

4 APRIL 1935

Dr. W. T. CALMAN, F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 21 March 1935, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted :—Frances Mary Ongley Waight, Charles Edward Hubbard, Ernest James William Barrington, Herold Georg Schweickerd, Humphrey Robert Hewer and Bertram Lloyd.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Ruby Elaine Dowling, Samuel Edward Wilson and Wilfred Ernest Watson Baker.

Certificates of recommendation of the following candidates for Foreign Membership were read for the first time :—Albert Francis Blakeslee, Christen Raunkiaer, Pierre-Auguste-Clément Dangeard and Gustav Senn.

Certificates of recommendation of the following candidates for Associateship were read for the first time :—Arthur Augustine Dallman and Arthur Patterson.

The President announced that the Council had unanimously resolved to award the Linnean Gold Medal for 1935 to Sir DAVID PRAIN, C.M.G., C.I.E., F.R.S.

The President read for the second time the proposed alterations to the Bye-Laws, Chapter II, Sect. II and Sect. IV.

In accordance with Chap. X, Sect. VII of the Bye-Laws, the following Fellows were elected, by show of hands, as Auditors of the Treasurer's accounts for 1934-35 :—

Representing the Council : Mr. N. B. Kinnear
Dr. John Hutchinson

Representing the Fellows : Capt. Cyril Diver
Mr. D. J. Scourfield

A Narcissus flower showing an abnormal development of the corona. (Exhibit.) By Mr. IOLO A. WILLIAMS.

MR. I. A. WILLIAMS exhibited an abnormal daffodil. In a parcel of mixed hybrid narcissi obtained from a nurseryman were two bulbs which produced similar flowers. These have the crown divided to the base into six segments, most of the segments being themselves divided to about one-quarter or one-third of their length. The segments are folded back against the perianth, leaving the style and stamens projecting. The exhibitor asked whether this form of narcissus had been recorded either as a casual freak or as a gardener's variety.

A symposium on THE SPECIES PROBLEM IN PHANEROGAMS was opened by the reading of the following papers:—

The General Problem. By Mr. J. S. L. GILMOUR.

THE species problem, in its broadest aspect, is that of devising a system of terminology that will adequately express the constantly developing concepts of modern taxonomy.

The present system, laid down during the eighteenth and nineteenth centuries, served, and still serves, reasonably well for the floras of little-known areas, but it has been found to be inadequate, if not a hindrance to progress, for the intensive study, aided by ecology, genetics, cytology, &c., of particular groups of plants in well-known floras. In all progressive sciences it is found necessary to create a new terminology as the increasing complexity of the observed phenomena is revealed, and this must inevitably be done in the case of the new intensive taxonomy. Several attempts on these lines (notably Du Rietz's comprehensive scheme in *Svensk. Bot. Tidskr.* 1930) have already been made, but there is no agreement among botanists as to how far old terms should be used or new ones coined.

Two schools of thought are illustrated by the speakers this afternoon. Dr. Turrill and Mr. Marsden-Jones advocate more research on the new lines before any radical change is made in the existing system, while Mr. Good demands immediate 'first-aid' action to alleviate the present state of confusion.

Whatever course is urged, all botanists will agree that the problem, which is of vital importance to the continued progress of botanical science, must be faced with an open mind and with no slavish adherence to a terminology that has outlived its usefulness.

The investigation of plant species.

By Dr. W. B. TURRILL.

THE species is frequently regarded as the most important taxonomic unit. It has certainly proved convenient to use specific designations for many botanical purposes, and unless an alternative scheme can be proposed which, after exhaustive tests, is found to be superior both in practice and in theory, it seems best to attempt improvements of the old scheme rather than to destroy it and leave a state of chaos. Existing taxonomy is largely tentative. This is unavoidable for many plant groups and for little-studied floras. It is suggested, however, that the time has come when the student of floras whose taxonomy on the old lines is relatively well known should attempt to investigate species by much more complete analyses of a wider range of characters than is now the rule. There is thus distinguished an alpha taxonomy and an omega taxonomy, the latter being an ideal which will probably never be completely realized.

The term species has been used for such groups or general populations of plants as are united by common morphological characteristics, are separated from other groups by constant morphological characteristics, which inbreed in nature and are isolated from other such groups. In using this or a similar definition one soon realizes how few are the trustworthy data available regarding even our common British plants for such criteria as inbreeding and isolation. It also becomes evident that the above criteria sometimes break down and that the limitation of species is then a matter of scientific convenience. Thus there can be no *a priori* objection to considering a given group for one purpose as a species, for another purpose as a subspecies or a variety of a larger group which is then considered as the species, so long as the facts and reasons are clearly stated. One must apply the pragmatic test—which method of dealing with the available data enables us best to correlate and to increase our knowledge. There is at present nothing absolute about a species, but, on the other hand, many, if not most, of the species accepted by the majority of those alpha taxonomists who have studied them do correspond to well-marked natural groups. The aim of the alpha taxonomist must be to complete the preliminary and mainly morphological survey of plant-life, and much remains to be done on these lines. The alpha taxonomist, however, really studies the constitution of the genus, not of the species; he ‘gets inside’ the genus but does not ‘get inside’ the species.

Those who, having been trained to an appreciation of modern discoveries in ecology, cytology, genetics, &c., are

trying to widen the basis of taxonomy, have undertaken a long, slow and perhaps thankless task. They have, however, a vision of a revived taxonomy in which an important place is found for all observational and experimental data relating, even if indirectly, to the constitution, subdivision, origin and behaviour of species and other taxonomic groups. Some of the criteria which those who aim at an omega taxonomy are already using were briefly considered under the headings ecological, genetical, cytological, and biometrical.

Finally, it is urged that those taxonomists who are free to choose their subjects should investigate a few species from every possible standpoint, and by a combination of all available methods, by extensive and intensive field observations, experimental cultivation, controlled breeding, and laboratory investigations. This work will not yield quickly such a large quantity of results as, for example, limited herbarium studies, but it is only by concentrated yet methodologically unlimited research that our ideal of complete knowledge as a basis for plant classification can be approached.

The genetics of *Anagallis arvensis* Linn. and

Anagallis foemina Mill. By Mr. E. M. MARSDEN-JONES.

ANAGALLIS ARVENSIS is recorded from 101 vice-counties according to the eleventh edition of the 'London Catalogue'. The leaves are generally ovate, but plants occur with the lower leaves ovate and the upper ones lanceolate. The colour of the corolla is usually the typical scarlet, but plants are to be found with salmon, flesh (the variety *carnea*) and blue corollas.

According to Ridgway's 'Color Standards' the colour of the scarlet is Grenadine, the salmon, Strawberry Pink, the flesh, Cameo Pink, and the blue, Deep Dull Bluish Violet.

On selfing they have all bred true through several generations; on crossing, salmon, *carnea* and blue are recessive to scarlet, and blue is also recessive to salmon and *carnea*. Salmon $\times$ *carnea* gave in the F_1 two plants with salmon flowers and one with scarlet.

There was no colour incompatibility in the F_1 when plants of *A. arvensis* with differently coloured corollas were crossed together; all the colours cross together readily and F_1 and subsequent families were fully fertile.

Anagallis foemina is recorded in the eleventh edition of the 'London Catalogue' from 56 vice-counties, but probably some of these records should refer to the blue form of *A. arvensis*. The leaves are, lower ovate, upper lanceolate. The colour of the corolla is blue, but not the same blue as in *A. arvensis*; Ridgway's description is Greyish Violaceous Blue.

The differences between *A. arvensis* and *A. foemina* are to be found in the corolla only, and can be summarized as follows :—

	<i>A. arvensis.</i>	<i>A. foemina.</i>
Colour, upper surface.	Scarlet=Grenadine. Salmon=Strawberry Pink. Flesh (var. <i>carnea</i>)= Cameo Pink. Blue=Deep Dull Bluish Violet.	Blue=Greyish Viola- ceous Blue.
Corolla	Segments usually overlapping to about half their length.	Segments not overlapping.
Diam. of corolla	Up to 1.4 cm.	Up to 1 cm.
Petal length.....	Up to 7 mm.	Up to 5 mm.
Petal breadth	Up to 6 mm.	Up to 3 mm.
Petal shape	Broadly-obovate.	Narrowly-obovate.
Petal margin	Entire or obscurely crenulate on different plants, glandular.	Denticulate or crenulate on the same plant and even on petals of the same corolla. Very sparingly glandular.

The following crosses have been made between *A. arvensis* and *A. foemina*: scarlet $\times$ *foemina*, colour of all plants in F_1 Bittersweet Orange; salmon $\times$ *foemina*, colour of all plants in F_1 Chatenay Pink; *carnea* $\times$ *foemina*, colour of all plants in F_1 as *carnea*; blue $\times$ *foemina*, colour of all plants in F_1 blue as in *A. arvensis*.

The leaves of these F_1 families were uniform as *A. foemina*, petal shape and number of glands as *A. arvensis*, petal margins crenulate.

The F_1 families obtained on crossing *A. arvensis* scarlet, *carnea* and blue with *A. foemina* were all sterile; these crosses will be repeated. A fertile F_1 was, however, obtained on crossing with salmon.

In the F_2 families all possible combinations occurred.

Status of *Anagallis foemina*: by some taxonomists *A. foemina* is considered to be a species, distinct from *A. arvensis*. Although no really satisfactory and standardized definition of a species has been arrived at, the claim of *A. foemina* to that status does not on analysis appear to come up even to the lowest existing conception. The differences between these plants are to be found in the corolla only; they are not only essentially quantitative but fluctuate to form continuous series. Still more important, the salmon *A. arvensis* gives a fertile F_1 with *A. foemina* and a highly segregating F_2 .

It is suggested therefore that *A. foemina* should be regarded only as a variety of *A. arvensis*.

The real Species Problem.

By Mr. RONALD GOOD.

I PROPOSE to open my remarks by expressing an opinion which I believe to be so widely held that it may reasonably rank as an assumption on which my further remarks may be based.

This assumption is that taxonomy not only occupies a peculiar place among the branches of botany, but that its relation to these other branches is, at the present time, something less than entirely satisfactory. That is my opinion, and I believe it to be shared by many others.

Taxonomy is one of the most specialized branches of botany, but it is specialized in rather an unusual way. Many aspects of our science are so highly technical that the average botanist cannot hope to have more than a superficial knowledge of many of them, but this superficial knowledge is generally existent. Not so with taxonomy. This branch of botany is not particularly technical compared with many others, but it is nevertheless peculiarly the province of the few, and is perhaps the only branch of botany of which the average botanist is almost completely ignorant. Yet taxonomy is one of the most fundamental subjects and has a direct connexion with every other.

The general truth of these statements will not, I think, be challenged. My purpose in making them is to emphasize the strange position that obtains to-day, a position in which one of the aspects of botany most intimately involved with all other aspects is, in fact, the most isolated and the most neglected. The reason appears to me to be that there has been on both sides a certain lack of co-operation and liaison, and that, resulting from this, taxonomy has on the one hand developed on too narrow a front, and on the other hand has been unduly ignored (I might almost say ostracized) by the non-taxonomists.

Taxonomists may be described as producers, their productions being the classifications and names of plants. The non-taxonomists may be likened to consumers, the aforesaid classifications and names being the commodities which they consume. Now the characteristics of a commodity are of importance not only to the consumer but also to the producer, since, if the two are to continue in amicable trade relations, they must be satisfied with one another. It must be economic for the consumer to remain the customer of the producer. This the producer seeks to ensure by giving close attention to the standard and utility of his wares.

It is inherent in my assumption that the producer or consumer or both have failed to achieve this desired end, and,

as I see it, the reasons for this have been two, the one being the cause of the other.

The immediate reason is, I believe, the fact that in taxonomic botany the producers are also to an unusually large extent the consumers, and that their commodities have come insensibly to reflect this fact, thus tending to lose their appeal for the general customer. The aim of the taxonomists seems to have gone awry. They have come to regard their responsibilities, I would suggest, in too artificial and rigid a way and without due regard to botany as a single homogeneous subject. Their work has become the classification of individual-aggregates into species rather than the study of the taxonomic constitutions of these aggregates. The question has become 'How many species does such and such a group contain'? instead of 'What are the similarities, differences and relationships between the individuals of the group'? Between these two questions there is a subtle but profound distinction.

How has this come about, and what is the second reason for the situation I have described. The villain of the piece is, in my view, an all too familiar friend, afforded for that very reason scope for his criminal tendencies. I refer to the word SPECIES. As I see it it is this word, and what it is capable of conveying, that is at the root of all the trouble.

This is a hard saying, but I would submit that it deserves very careful examination. Take the very familiar words 'species problem', which are incorporated in the title of to-night's discussion. What do they mean? The phenomena of nature involved are objective facts, and there is no inherent problem in them at all. The problem arises as a result of the human factor. It is a man-made problem. It lies not in what we can observe, but in a purely extraneous attempt to relate them to an imponderable, the species. The problem, bared to the bones, is after all not a botanical one but an etymological one, the problem of what a species is.

The fact that a species cannot be defined and has no absolute value is so old and so hackneyed that I hesitate to repeat it here, but I must do so deliberately, because it is this very familiarity that causes the essential truth of the statement just made habitually to be glossed over. We talk of species being this or that, and we tacitly ignore the fact that we do not, actually, know what we are talking about.

It is time that we faced squarely the undeniable, if unpalatable, truth that no amount of fresh knowledge will change the word species into a practicable scientific term. The word is permanently disabled and vitiated for modern employment because it cannot successfully be divorced from the

pre-Darwinian conceptions amid which it had its biological birth. The word was originally intended to mean something, and did mean something unmistakable. That meaning has now vanished, and with it the word itself should also disappear.

Looking at the word species as dispassionately as possible one inevitably wonders why it is still in use at all. What is its attraction? I cannot help believing that it resides in its Linnaean associations and its contemporary connotation. These give to it a fictitious but none the less tempting prestige-value, and by invoking it this value is transferred to taxonomic units. In almost exactly the same way villas masquerade as castles and inns as hotels. To take a more germane example, much taxonomic confusion is caused by the elevation of minor categories of difference to the rank of species. This, I cannot help feeling, is often done, subconsciously perhaps, because the units thus become invested with an importance and prestige which they would not otherwise achieve. It is an old adage that people are taken at their own valuation, and no doubt it may be applied to species also.

Apart from such arguments I confidently believe that if the word species continues to be used as it has been used in the past the position will become more and more untenable. Fresh discoveries are daily making it more and more impossible for us to classify organisms on this basis, and in no direction is this more notable than in genetics, as has been made clear earlier this evening. Something will very soon have to be done, and the sooner the better for all concerned.

But destructive criticism is all too facile, and I have raised issues which demand a remedial suggestion.

I have criticized the word species, and I have sufficient faith to believe that I do not stand quite alone in this matter. At the same time I am not so optimistic as to imagine that the word will easily be discarded, but that is no reason why its baleful use should not be restricted as far as possible. It should be stigmatized as an anachronism, and there should be made available for alternative use a word having reference only to the factual observable differences between individual organisms. At least two terms of this sort already exist, namely, phenotype and morph, and either will serve, simply as an example, to convey my meaning here. Let us take some such term, and classify the British Flora once again right from the very beginning, with a clean slate and an open mind, solely on the basis of the visual differences between individuals. Let us forget all about species, for the time being at least, and let us produce something which will be a statement of fact and not of fiction, assumption or belief. Let us compile what I may call a phenotypic or morphic (i.e. factual)

classification of our country's flora, uninfluenced either by former classifications or by what a species may or may not be.

Such a classification would, for the first time, provide an account of the assemblies of individual plants which constitute our flora without attributing to any of them more than can be seen with the eye and described by the written word. It would provide a statement of fact to which workers in every branch of science could turn with confidence and with understanding, and without fear of ambiguity. Above all it would make no statements which could not immediately be verified or disproved by an examination of specimens.

Such a classification *need* be used by no one, but it would be available for all. I do not for a moment suggest that it should, with intention, replace or supplant any existing floras (though I am confident that it would do so naturally), but I do suggest that it would place a valuable working implement in the hands of many, and I number myself among them, who are at present compelled to use classifications in which they have little or no confidence.

Mr. A. J. WILMOTT considered that one of the chief reasons for disagreement in this problem was that the one word 'species' was used for so many different concepts. Apart from the mere 'taxonomic species', i.e. a description with a biverbal name attached, there were 'aggregate' species and 'small' species of various kinds. His experience was that, except in special groups with some peculiar means of reproduction which gave rise to special categories, the sound workers in all groups of both animal and vegetable kingdoms could reach approximate agreement as to the categories of variation which existed in nature; it was only concerning which of these categories was to be called the species that they could not agree.

The criteria of specific difference were quite simple, viz. the correlation of independently inherited genes and a distinct distribution. The difference in distribution might be geographic or ecological, but distribution was the ultimate test. The statement that a character given by some author was a bad character merely meant that the character had no definite distribution correlated with that of other characters. When this correlation of characters and peculiar distribution occurred the lineage was found to be different throughout the plant; a specialist who knew his group in detail could usually identify even a fragment of a plant, because the growth, the leaves, the flowers, the fruit were all different.

One curious idea needs to be destroyed, that species must be uniform in size. Nobody expects families to be of the same size, nor even genera; and species are not of the same size

It is immaterial whether the definitive characters are many or few, obvious or obscure. If they are correlated and the lineage has a distinct distribution the difference is specific.

The fact that intergrading may occur and that no absolute specific criterion is known does not deny the existence of specific difference. In *Onosmas* of the *echioides* group most of the geographically isolated units are quite distinct, but some, although geographically isolated, have no absolute character. Yet all must be of the same actual natural rank. When intergrading occurs in this way the term subspecies should be used. (No one would deny that branching had actually occurred if shown a section of a stem made near the junction of a branch shoot where two vascular systems were surrounded by a single cortex. The 'species' are only sections of lineages, and intergrading may only show a similar proximity to the point of branching.)

There are different kinds of species, with different origins. They may have arisen by differential variation and differential selection in isolated stocks of one species. The isolation can have been geographical or due to sterility. New species can arise by chromosomal doubling or other aberrations. But sterility itself is no test of specific difference; in plants we can have self-sterility, as in *Reseda*, and if we used this test we should have to unite in one species the great proportion of species in some large genera.

What is required is adequate study and nomenclature of these diverse categories which occur. Possibly we shall need to add prefixes to the term species to indicate the different kinds. Species of the geologist may be different sections of the *same* lineage. But once the categories are determined the problem of species becomes a purely taxonomic problem, viz. which of these categories shall bear the biverbal name and be termed species.

Varieties, *lusus*, and the like, should not be named. We are not here dealing with kinds of organism, i.e. species, but with genes, or, rather, with the 'phenes' to which they give rise. It is the distribution of these genes that is under investigation, and a nomenclature should be devised by which the individuals bearing them can be catalogued and the distribution of the genes ascertained. In some cases it is probable that similar variations in allied species, even in allied genera or even again in allied families, may be due to the same genes, and this does not primarily concern the species and taxonomy; it primarily concerns genetics and phylogeny, and only secondarily concerns taxonomy.

Professor R. R. GATES said that a symposium of this kind was useful in that it enabled the taxonomist, the geneticist, the cytologist and the ecologist to consider the species problem

from other points of view than his own, and should thus lead to greater harmony of view. He entirely agreed with nearly everything that Dr. Turrill had said. Such terms as Linneon and Jordanon, ecospecies and phenotype, showed that in practice different kinds of species were being considered. He also agreed with the statement of Mr. Wilmott that species differed not only in the degree but also in the kinds of distinction between them. This was partly because mutations, which furnished the raw material for species, were of various sizes and kinds. He had always held that every biologist should have an intimate first-hand knowledge of the taxonomy of some group of organisms, including its variations and bionomics. This would give him the best understanding of the nature of specific differences.

Three years ago he had made nearly a hundred collections of seeds of *Oenothera*, mainly in Eastern Canada, in a genetic survey. He was now growing the third generation of these cultures, and they sorted into something like twenty-five new species. Sometimes two or three perfectly distinct species were found in the same area, but when one followed them into other areas they began to show variations. It then became a problem where the line was to be drawn between that species and the next. In this sense most species were judgments.

The ultimate ideal was no doubt the complete cytological and genetical analysis of every species in our flora. He had much sympathy with the views of Mr. Good, but the phenotypes of many species were innumerable, and the environmental had to be sorted out from the genotypical effects. Perhaps this meeting would lead to someone attempting a classification of the phenotypes of some British species on the lines suggested. They would find it a very large undertaking, but its results would be well worth while, and it would be a form of applied genetics as well as throwing light on taxonomic distinctions.

Dr. K. B. BLACKBURN stated that from the point of view of the field naturalist the present method of naming plants works satisfactorily in nine cases out of ten. The problem in the remaining ten per cent is that the difficulties are of such a varying nature that no one remedy could possibly resolve them. If we look to the chromosomes to help in determining the status of forms we are again confronted with the same sort of problem: in *Silene ciliata* there are differences in chromosome number in different stocks, but the only clear line of demarcation is a geographical one, whereas in *Salix alba* it is possible to distinguish the variety *caerulea* more clearly by chromosome differences than by other morphological characters. It appears that until we can see the various problems involved more clearly any drastic

alteration in the manner of designating plants would be a far from helpful step.

Mr. E. F. WARBURG agreed that it was the barriers between the species that made the species. These barriers may be of various kinds. In *Cistus* the species are in general clear-cut, and those proposed by the early authors have stood the test of time though numerous hybrids and geographical races exist.

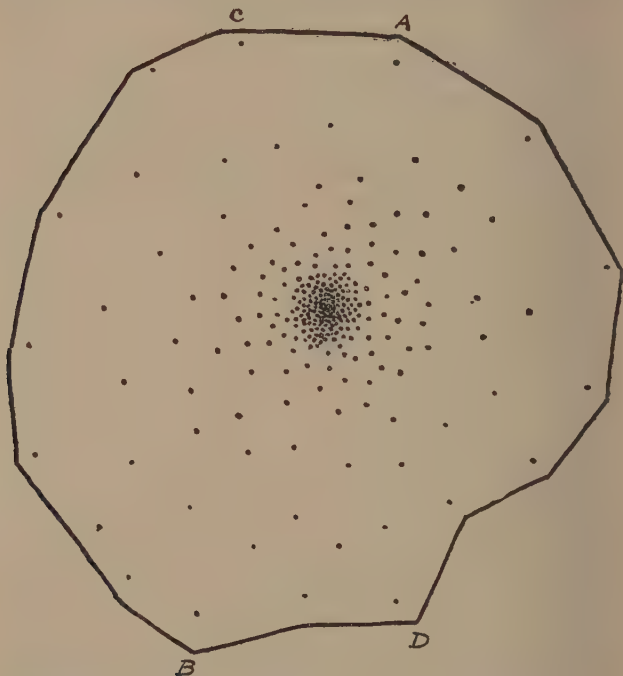
Dr. R. W. BUTCHER said the species binomial may be described as the sheet anchor of our system of nomenclature, and whatever changes may be made in the conception and definition of species, variety, ecotype and such-like, the binomial founded by Linnaeus should be left intact. The laboriousness and confusion when one has to write such names as *Festuca ovina* subsp. *rubra* var. *fallax* subvar. *vivipara* forma *hirsuta* ecad *aristata* to every plant named or described will exceed that produced in the pre-Linnean days of many worded Latin epithets.

Even now botanical nomenclature is the despair of the young student, so the simplicity of the binomial is also of fundamental importance when imparting to others, especially beginners, what we ourselves have learnt. The complicated system proposed by certain speakers would undoubtedly turn many a young student away from the idea of reading botany, and if this happens there could be very little progress in taxonomic investigations.

A lot of our difficulties arise by the attempt to define species too narrowly. The concept of species requires to be widened rather than narrowed. It would not be an exceedingly difficult task to incorporate all the advances of our knowledge of the taxonomy of well-known floras (Dr. Turrill's omega-taxonomy) within the concept of the species as represented by the binomial term. At the most it would appear to necessitate simply the careful elimination and regulation of the duplication of trivials in all plants included under a species, and perhaps the adoption of a trinomial in some cases, but certainly not the employment of a string of names.

Professor W. B. BRIERLEY said: It may be a little unwise to consider the species problem only in phanerogams, since it is a problem common to living things. It may help if I discuss it in, for example, the fungi, where it can be examined intensively, and then apply the findings to phanerogams. In nature there are only individuals—not species, genera or other abstract categories. The individual phenotype, morphologically and physiologically, is conditioned by the interacting genotype and environment—that is, there are no fixed morphological and physiological 'types', but only innumerable phenotypes, which converge to a mode in more

normal environments and scatter centrifugally as conditions become extreme (fig. 1). The limits of phenotypic modification are set by lethal conditions, and individuals with approximately similar modes and limits, i.e. similar genotypes, constitute a race. There are numerous races, and each is defined



The diagrams are two-dimensional, but should be conceived as multi-dimensional space-time relationships without limiting planes.

FIG. 1.—Representation of the phenotypes of an individual, showing condensation to a modal point with conditions of increasing normality, and centrifugal scattering as lethal boundaries are approached. Points 'A' and 'B' might represent minimum and maximum extremes of any one environmental factor, points 'C' and 'D' of any other.

by its modal values and its range of phenotypic modifiability, which may be of greater or lesser extent and which may overlap into the range of one or more other races (fig. 2). Such a cluster of races is a species, and a cluster of species is a genus (fig. 3), and so on to higher categories. Each

species-cluster may contain a larger or smaller number of races, and these condense in varying degree about one or more loci or modal points, thus producing one or more varieties. The species-clusters are more or less remote and distinct from each other, although occasional races seem to occupy positions between species-clusters (fig. 3).

Races are not entirely constant in time, since they are subject to gene mutation, genetic summation and segregation,

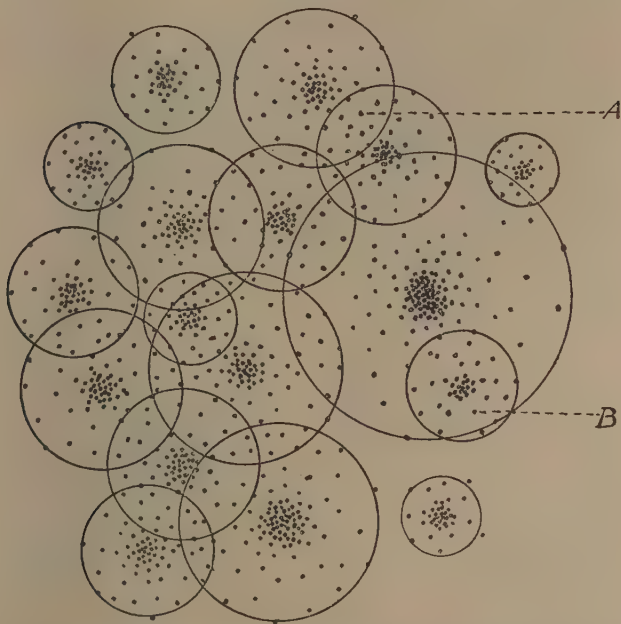


FIG. 2.—Representation of clustering and overlapping of races, some with larger and others with smaller ranges of phenotypic modifiability. Such a cluster of races constitutes a species. The races to which e.g. phenotypes 'A' and 'B' belong can be determined only by experimental analysis.

but these changes with perhaps very rare exceptions occur only within the limits of the particular species-cluster. The species-clusters are more constant, but two clusters may be bridged by species-hybridization with its resultant phenomena, or possibly, although I think very rarely, by major mutation, possibly of two or more genes concomitantly. The species-clusters are essentially disparate genic clusters.

As any individual phenotype is conditioned by its environment (fig. 1), and as the individual races overlap into each other (fig. 2), it is often only possible to determine the race or species to which an individual belongs by analyzing its phenotypic modifiability.

This 'orbital conception of systematic categories' (Brierley, W. B., 'Biological races in fungi and their significance in evolution', *Ann. app. Biol.* xviii. 3, pp. 420-34, 1931), which is

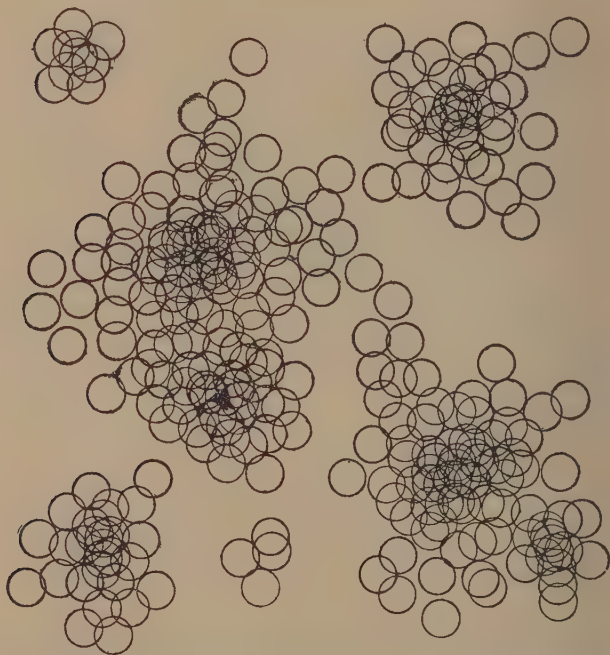


FIG. 3.—Representation of clusters of races, each cluster constituting a species, and the cluster of clusters constituting a genus. Two of the species-clusters contain two modal points representing varieties: a species contains as many varieties as its cluster contains modal-point condensations, and the varieties are as distinct as the cluster condensations are disparate.

analogous to a multidimensional space-time system, applies not only to the fungi but, so far as I can see, equally well to other cryptogams, phanerogams, and also to the animal kingdom. It is clear that in animal and plant systematy there is no exact and logical alignment of taxonomic values and categories, but, generally speaking, if one applies this

orbital conception to phanerogams, the fungal phenotypes correspond with phanerogamic phenotypes, the fungal races equate with Lotsy's 'Jordanons' or Turessen's 'biotypes', the modal-clusters within the clusters of races are equivalent to varieties, the clusters of races are equivalent to Linnaeus's 'species' or Lotsy's 'Linneons', and the cluster of species-clusters is the genus. It is also clear, resulting from the foregoing species concept, that the museum or herbarium 'type' specimen only possesses significant value in the degree to which it approaches the modal point in the species-cluster: in racial and individual values it is merely one of innumerable phenotypes.

Mr. J. RAMSBOTTOM said that the title of the symposium had at first no special reference to flowering plants. It needed to be stressed, however, that different difficulties and problems were encountered in different groups—some of the criteria which might be used in flowering plants were useless, for example, in fungi, bacteria and fossils. Professor Brierley had referred to microfungi, but mycologists appeared to be more favourably placed than most botanists, and were rapidly accumulating data which seemed likely to provide a working system for the recognition of those species readily cultivated. In the larger forms, toadstools and their allies, there is so much variation that the labour involved in following out some such suggestion as that of Mr. Good makes it impracticable.

Taxonomy in flowering plants has been somewhat unfortunate because after the introduction of the much lauded 'new' botany many university schools seemed to forget that taxonomy is an important branch of botany. This has meant that much of the work has been carried out by amateurs, and consequently has been mostly on the old lines.

The older taxonomists were nothing like so narrow in their outlook as some modern herbarium workers are said to be. He would like to ask Dr. Turrill whether he agreed with the following as a fair paraphrase of his ideas about an omega taxonomy: 'Botanical classification, when complete and correct, will be an epitome of our knowledge of plants'. This is a quotation from Asa Gray's 'Structural Botany', and probably represents the attitude of the majority of systematists. Every aspect of botany should be kept constantly under review in striving to formulate rational principles. But it is absurd to criticize the herbarium botanist because, having to work with small portions of dried plants, he is unable to do certain things: he is as successful with his methods as is the botanist in any other branch of the science, and is equally aware of the general principles underlying ideal practices. The more we know about individuals the greater the chance of a natural classification, but with modern methods of micromorphology there is a danger of getting

down to the recognition of individuals and overlooking the fact that our object is to classify them. A consideration of the modern finger-print methods in relation to *Homo sapiens* will provide much for the taxonomist to ponder over.

Dr. T. A. SPRAGUE and Dr. F. G. BRIEGER (Visitor) also spoke.

[Sir ARTHUR W. HILL sent in the following remarks, which he had been unable to make at the meeting owing to a misunderstanding:—

Linnaeus and his followers were, I believe, correct with regard to the existence of species as distinct and concrete entities. Now and again doubts may arise as to the sharpness of the boundary line between two nearly related species, but further research will probably show *either* (1) that hybridization may be taking place, as has been found in certain cases in the British flora (e.g. *Centaurea*) and to a remarkable extent in the New Zealand flora, *or* (2) that the species in question are in a plastic condition, indicating possibly that a species is in an evolutionary state, easily influenced by conditions (?epharmonic), and may in the course of time give rise to two or more entities, each of which may then be considered as distinct species.

A further point was suggested by Prof. Brierley's illustration of *Botrytis* species. It is clear that while some species of flowering plants are highly plastic and respond quickly to environmental and soil conditions others are remarkably stable. This may quite probably be due to the fact that some species are 'waning' and others 'waxing', and are by no means stable—yet all the same these latter can be clearly defined, but with rather more latitude than in the case of the more stable ones. *Taraxacum officinale* might be considered a good example of the 'waxing' type, *Polygala calcarea* possibly of the more fixed species.

The British flora offers a good field for a careful survey of species of different types, but it also demonstrates clearly the value of the recognition that *species* are real entities, and that they do not pass their bounds unless hybridization or some disturbing ecological factors upset the balance.

Tropical floras present considerable difficulties, since it will be long before they can be studied with the same intensity as those of temperate regions. In the Rain Forests stability among the species may have been attained to a considerable degree, though no doubt in some cases a species will be found to include a fairly wide range of somewhat divergent forms. Among the herbs, however, similar problems to those of temperate regions will probably be found to occur as knowledge increases.

The problem as to a *species*, I submit, is not Willis's 'age and area', but is essentially one of *age*. Is a species on the

ascending or descending curve? The answer may or may not be associated with the extent of the area it occupies. Our task is to try and discover, by careful study of individual species, whether they are on the ascending or descending curve of development. Should a species be found to be on the ascendent scale, then the phenotypes included within a definite species limit could be distinguished according to our inclinations.]

The President conveyed the thanks of the meeting to all those who had spoken on the subject.

25 APRIL 1935

Dr. W. T. CALMAN, F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 4 April 1935, having been circulated, were taken as read and confirmed.

The following Loyal Address, which had been prepared by the Officers and approved by the Council, was read and unanimously adopted; all present rising from their seats:—

To The King's Most Excellent Majesty.

THE HUMBLE ADDRESS OF THE PRESIDENT,
COUNCIL, AND FELLOWS OF THE LINNEAN
SOCIETY OF LONDON

May it Please Your Majesty

WE, your dutiful and loyal subjects, the President, Council, and Fellows of The Linnean Society of London, humbly beg leave to offer our congratulations upon the completion of the twenty-fifth year of Your Majesty's Reign.

As a Society devoted, under the Patronage of Your Majesty, to the advancement of Natural Science, we recognise with the highest satisfaction that during Your Majesty's Reign great advances have been made in the knowledge of Nature, and that the application of that knowledge has contributed to the welfare of Your people and to the alleviation of suffering.

It is our earnest hope that Your most Gracious Majesty, with Her Majesty the Queen, may long continue to reign over Your devoted and loyal subjects.

Given under the Common Seal of the Society, this twenty-fifth day of April in the year one thousand nine hundred and thirty-five.

W. T. CALMAN, *President.*

L.S.

J. RAMSBOTTOM, }
STANLEY KEMP, } *Secretaries.*

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted :—Comyns John Augustus Berkeley.

Certificates of recommendation of the following candidates for Fellowship were read :—For the first time, in favour of Cyril Francis Hill and Francis Colville Minns.

Certificates of recommendation of the following candidates for Foreign Membership were read for the second time :—Albert Francis Blakeslee, Christen Raunkiaer, Pierre-Auguste-Clément Dangeard and Gustav Senn.

Certificates of recommendation of the following candidates for Associateship were read for the second time :—Arthur Augustine Dallman and Arthur Patterson.

The proposed Alterations to the Bye-Laws, Chapter II, Sect. II and Sect. IV, were balloted for and adopted.

The botany of the islands in the Gulf of Guinea.

By Mr. A. W. EXELL.

THE four islands of Fernando Po, Principe, S. Tomé and Annobon, situated in the eastern part of the Gulf of Guinea, lie along a line of volcanic activity in a direction roughly N.E.—S.W. To the north-east the chain is continued by Cameroons Mt., while about 1,200 miles to the south-west, in the same direct line, lies St. Helena, probably a product of the same volcanic activity, but so distant from the other islands and so different in climate that it has no biological relationship with them.

Fernando Po, the largest island (43 by 20 miles) is only 19 miles from the mainland, and reaches an altitude of 9,300 ft. ; Principe (10 by 5 miles), 130 miles from Fernando Po and about the same distance from the mainland, reaches 2,700 ft. ; S. Tomé (29 by 17 miles), lying 90 miles from Principe and 150 miles from Gaboon, culminates in the Pico de S. Tomé, 6,600 ft. in altitude ; Annobon (4 by 1½ miles), the smallest, is 110 miles from S. Tomé, 230 miles from Gaboon, and reaches an altitude of 2,100 ft. S. Tomé lies practically on the equator.

All four islands have a typical equatorial climate, hot but not excessively so, with considerable rainfall and very high

humidity. Fernando Po has the northern climate-type with a dry period in January, while the other three have the southern climate-type in which July is the driest month. Fernando Po has the heaviest rainfall, while Annobon seems to be somewhat drier than the other three. Exact meteorological information is not available for all the islands.

S. Tomé, which may be taken first as the most useful basis for comparison with the other islands, was discovered by the Portuguese in 1470. At this date it was uninhabited and densely clothed with high forest. By the middle of the sixteenth century the island had already been largely planted with sugar-cane. Much later cocoa was introduced, and further destruction of the forest took place on a large scale until, at the present day, only a small area of virgin forest remains on the crests of the mountains. This destruction of the forest makes recognition of the original zones of vegetation difficult, but the altitudinal ranges of the cultivated plants are of some assistance. Four main regions can be recognized, though the boundaries between them are mostly indistinct. (1) *Littoral region*. The coast consists partly of sand-dunes and partly of volcanic rock. Here and there, especially where the rivers have brought down mud, are patches of mangrove, *Rhizophora racemosa*, associated with *Dalbergia Brownei*. The sand-dunes are colonized by *Ipomoea pes-caprae*, *Canavalia obtusifolia*, *Cynodon dactylon* and *Sporobolus virginicus*. Associated with these, usually a little further from the sea, are a number of common tropical weeds, mostly introduced and of little interest. The algal flora is poor. The commonest species seem to be *Sargassum vulgare* and *Ulva fasciata*. The coast is often lined with coco-nut palms, the trunks of which are sometimes coloured bright orange-red by a species of the lichen *Opegrapha*. (2) *Lower rain-forest region*. This extends from sea-level to about 2,600 ft., and is now almost entirely under cultivation, though some members of the original flora survive as shade-trees in the plantations. The principal trees were probably *Adansonia digitata*, *Ceiba pentandra* (the 'Océ' of the natives, with enormous buttresses), *Chlorophora tenuifolia*, *Treculia africana*, *Celtis Prantlii*, *Celtis Durandii*, *Celtis Soyauzii*, *Mesogyne Henriquesii*, *Trema affinis*, *Musanga Smithii*, *Ficus* spp., *Parinari excelsa*, *Parinari macrophylla*, *Tetrapleura Thonningii*, *Cynometra Mannii*, *Tamarindus indica*, *Lonchocarpus macrophyllus*, *Pseudospondias acutifolia* and *Pentadesma butyraceum*. *Thunbergianthus Quintasii*, an interesting endemic belonging to the Scrophulariaceae, and a number of endemic orchids are found in this region. (3) *Mountain rain-forest region* (2,600–4,500 ft.). The transition to this region is a gradual one, characterized rather by a change in the constituents of the forest than in its

general aspect. The main climatic factors involved are a much lower mean minimum temperature, a very much lower absolute minimum temperature, a much greater rainfall and a much higher humidity. The principal trees are *Conopharyngia stenosphon* (the 'Pau Lirio' with sweetly scented flowers), *Thecacoris Manniana*, *Olea Welwitschii*, *Kickxia africana*, *Oxyanthus speciosus* and *Ouratea Molleri*. Many of the forest-trees are probably still unidentified, owing to the difficulty of collecting flowers and fruits from them. Tree-ferns, *Cyathea Welwitschii* and *C. Manniana*, are abundant, and ferns in general are a prominent feature of the vegetation. The humid atmosphere favours the growth of epiphytes, and the trunks of the trees are often almost hidden by a dense covering of epiphytic lichens, mosses, ferns, orchids and species of *Begonia* and *Peperomia*. *Begonia baccata*, *Impatiens buccinalis*, *Leea tinctoria*, *Orestias elegans* and *Costus giganteus* are among the most striking members of the flora. The interesting Euphorbiaceous tree *Pseudagrostistachys africana* is also fairly plentiful, and the endemic *Heteradelphina Paulowilhelmia*, belonging to the Acanthaceae, is to be found in the crater of an extinct volcano known as Lagôa Amelia. The proportion of endemics in this region is high. (4) *Mist-forest region* (4,500 ft. upwards). In this region the temperature is still lower, but probably never so low as freezing-point. Rainfall is very heavy and cloud and mist are almost constant, so that the amount of light is considerably reduced. The trees are much smaller and are almost choked by epiphytes, which here reach their maximum development. Typical species of this region are *Schefflera Mannii*, *Anthocleista* spp., *Rubus pinnatus*, *Adinandra Mannii*, *Podocarpus Mannii*, *Utricularia bryophila* and *Philippia thomensis*. The proportion of endemics is very high indeed.

In S. Tomé there is thus a distinct montane flora, but it is almost entirely derivative from the typical tropical flora. The only temperate elements are *Stellaria* sp. nov., *Alchemilla Chevalieri* and *Carex leptocladus*.

Príncipe has a climate and flora resembling those of S. Tomé in their main features, but direct comparison of the floras is made difficult by the fact that such forest as survives in Príncipe is at a much lower altitude than the remaining forest in S. Tomé. The forest was largely destroyed in a campaign against sleeping sickness some thirty years ago, and the island is mainly covered with cocoa plantations similar to those of S. Tomé. Some forest which remains fairly untouched, at about 1,800 ft. altitude, seemed very similar to the S. Tomé forest at about 3,000 ft. The smaller the island the greater seems to be the effect of the altitude on the vegetation. The summit of Pico Papagaio (2,200 ft.) yielded

some interesting new genera and species, including a new genus of Cyperaceae, a new genus of Orchidaceae and new species of *Impatiens*, *Canthium*, *Chrysophyllum* and *Bertiera*. A feature of the island is the abundance of Connaraceae, the fruits of which are particularly striking. Out of 267 species only 138 are common to Principe and S. Tomé, while only three species are endemic to the two islands.

Fernando Po has a flora much less insular in character and closely allied to that of the near-by Cameroons Mt. With only a short time at our disposal a visit was paid to the interesting Moka grassland region, which lies in the south of the island at an altitude of 4,000–6,000 ft. This region is quite devoid of high forest and is in general aspect not unlike a Surrey common. Typical trees are *Clausena anisata*, *Macaranga occidentalis*, *Pavetta Exellii*, *Maesa lanceolata*, *Ilex mitis*, *Schefflera* sp., *Anthocleista scandens*, *Myrica arborea* and *Strombosia Scheffleri*. These form a light woodland, very different from the S. Tomé forest, or occur as isolated specimens in the grassland. Further characteristic species are *Senecio Mannii* (a tree-*Senecio*), *Lobelia columnaris*, *Hypericum lanceolatum* and *Lissochilus Horsfallii*. It is particularly noteworthy that such species as *Senecio Mannii* and *Lobelia columnaris* occur at an altitude as low as 3,000 ft. Tree-ferns (*Cyathea Manniana*) are abundant, and are even to be found in pure associations forming small woods. The main grass of the grassland is *Paspalum conjugatum*.

This montane flora contains a far more important temperate element than does that of S. Tomé. It includes species of *Clematis*, *Thalictrum*, *Ranunculus*, *Stellaria*, *Alchemilla*, *Viola*, *Crassula*, *Sanicula* and *Geranium*. Compositae and Acanthaceae, which are poorly represented in S. Tomé, are here abundant, while orchids and ferns are less prominent. Moka Lake, at about 6,000 ft., is surrounded at the water's edge by an interesting association of *Scirpus brachyceras*, *Begonia poculifera* and *Osmunda regalis*. Behind this is a belt composed mainly of *Cyathea Manniana*, with occasional specimens of *Schefflera* sp. *Begonia poculifera* is again associated with these. The great majority of these montane species of Fernando Po are also found on Cameroons Mt.

The contrast between the vegetation of this Moka region and the forests which are found at the same altitude in S. Tomé is very marked, and cannot be explained by any climatic difference. It is true that at Moka the temperature is much lower at night than it is at a similar altitude in S. Tomé, and it has occasionally been known to freeze, but this appears to be due to the absence of forest rather than *vice versa*. High forest acts almost as a cloud-banket in maintaining the temperature at night. The absence of forest may be due to

the fact that Fernando Po has always been inhabited while S. Tomé was uninhabited when discovered. Frequent forest fires (the natives still fire the bush at Moka) may have destroyed the forests in the Moka region and given such montane plants as *Senecio Mannii* and *Lobelia columnaris* the opportunity to descend to lower altitudes than they would normally inhabit.

Annobon, the smallest and most isolated of the four islands, has already been fully described by Dr. Mildbraed. The littoral region shows no features of special interest. The foreshore consists of a savannah-like formation of tall grass and isolated trees with patches of cultivation. Round the crater-lake and on the mountain peaks there is an evergreen rain-forest in which *Olea Welwitschii*, *Antidesma membranaceum*, *Rauwolfia vomitoria*, *Lannea* sp., *Clerodendrum* and *Polystachya tessellata* are to be found. In some respects there is a tendency for the flora to resemble the oceanic island-type. The flora is poor in species and the percentage of Pteridophyta is high.

In comparing the flora of the four islands it is remarkable that only twenty-four species are common to all of them and that extremely few species are endemic to two or more islands. On the other hand, the individual islands are rich in endemics, especially S. Tomé, in which the degree of endemism is 1 : 4·7. In general one may conclude that the islands were the result of intense volcanic activity, probably in the late Tertiary; they were never joined to each other nor to the mainland, with the possible exception of Fernando Po; and they received their floras from the mainland independently of each other, each receiving a somewhat different selection. The flora is of the general West African rain-forest type. The flora of Spanish Guinea is not sufficiently well known to work out in detail the continental distribution of the island species. The floras of Southern Nigeria and the Cameroons are so much better investigated that a false emphasis would probably be given to the figures. Annobon has been influenced to some extent by the proximity of S. Tomé, and the montane flora of S. Tomé shows some relationship with that of Fernando Po, though the temperate element is well evident in the latter and has scarcely managed to invade S. Tomé at all. On the other hand, S. Tomé has at least two interesting montane species, *Podocarpus Mannii* and *Adinandra Mannii*, which may be relics and have not been found in Fernando Po up to the present.

The proportion of Pteridophyta increases steadily with distance from the mainland, being 8·7 per cent in Fernando Po, 16 per cent in Principe, 18·8 per cent in S. Tomé, 21·6 per cent in Annobon, and, for comparison, 30 per cent in St. Helena and 50 per cent in Tristan d'Acunha. Even in Fernando Po

the percentage is high in comparison with figures for a European flora—e.g. 4 per cent in Denmark.

Dr. A. B. RENDLE emphasized the importance of the botanical study of these islands, especially where the original vegetation was threatened by extension of cultivation. It was satisfactory to hear of the persistence of the original forest on the higher parts of the mountains of S. Tomé, and he asked whether this was threatened by the spread of cultivation. He also asked whether Mr. Exell had noted specific cases of extinction of the original flora as compared with previous records.

Dr. J. M. DALZIEL said that the flora of the Biafra Islands raises many problems which can best be determined on the spot by a competent and enthusiastic botanist such as Mr. Exell collecting and observing in person over a period of a few months. There would be advantages in extending that period to a full twelve months if possible in both Fernando Po and S. Tomé, as these islands, though geographically not far apart, have a different type of season. This remarkable phenomenon implies in Africa, in a very broad sense, that in the area to the north and west of the region under discussion the chief rains occur during the months of the European spring and summer, and the drier months are during our winter, while a somewhat abrupt change occurs about the latitude of Spanish Guinea (on the west coast, but at a different latitude in East Africa), so that the seasons are reversed. S. Tomé has the latter type, while Fernando Po, lying farther north and near to Cameroons Mt., has the former. Mr. Exell had shown how different were their respective floras, although the geological composition is probably similar. All four islands lie in a direct line with the main axis of Cameroons Mt. (which is not a peak but a ridge lying N.N.E. to S.S.W.); the same line continued into the Atlantic includes St. Helena, and, extended into the continent, it included numerous volcanic peaks (some with crater-lakes), lava flows and masses of consolidated tufa, &c., all of much the same nature as the islands themselves. This line is known to German geologists as the Cameroons tectonic line of volcanic instability. Cameroons Mt. itself, the flora of which is similar to that of Fernando Po, was the first to arise as an island protruding through the later Cretaceous layers in a wide bay. On a relief map it appears, in its detachment from other mountain areas and its position almost on the coast, quite like an island, but, becoming soon joined to the mainland, its flora was no doubt a direct colonization. Fernando Po, separated by about twenty miles and a channel not very deep, may have been at one time connected to the continent. The other islands, separated

by deep channels, may possibly never have been so connected, though this is uncertain, and thus would be colonized by the usual aerial channels and by human agency. The area of mountain pasture at Moka on Fernando Po might contain exotic elements, and European cattle had been introduced. On Cameroons Mt., at Buea (3,200 ft.), the Germans made a dairy-farm on slopes cleared from the forest, preparing the soil by lucerne or other leguminous plants before sowing fodder-grasses both indigenous and introduced. It is not a natural formation.

With reference to Dr. Dalziel's question whether any grasses were common to the Moka grassland and the grasslands of the mountains on the mainland of Africa, Mr. J. E. DANDY mentioned that a connexion is provided by *Panicum Hochstetteri*, which was collected by Mildbraed at Moka and occurs on Cameroons Mt. and the mountains of East Africa.

In reply to Dr. Rendle, Mr. EXELL said there is considerable danger that the forest in S. Tomé will eventually be entirely destroyed, and measures are urgently needed to preserve a portion of it. It is one of the areas of primitive tropical forest most easily accessible from Europe. A number of species endemic to the island are probably already extinct. In reply to Dr. Dalziel, he stated that the grassland at Moka seems to be mainly composed of indigenous grasses, but *Poa annua* has been introduced to some extent.

The developmental mechanics of normal and abnormal flowers in *Primula*. By Dr. F. G. BRIEGER. (Communicated by Prof. F. E. WEISS, F.R.S., V.-P.L.S.)

FLORAL abnormalities were studied in the following mutants of *Primula sinensis*: 'claw', 'fertile double', and 'pistilloid,' and in one new type of *P. kewensis*. The forms 'green beetle' and 'old double' of *P. sinensis* which were also investigated gave no results of general importance and were not discussed.

These studies have furnished evidence concerning the morphological structure of the free central placenta, typical for the Primulaceae. This type of placenta and the whole structure of the ovary of the Primulaceae have been explained in several different ways. The following two points are generally accepted. The ovary wall is formed from several completely fused carpels, the number of which cannot be determined with any accuracy. The innermost part of the placenta is a prolongation of the axis. It is furthermore accepted by several authors that this axis is almost completely covered by an outgrowth of the carpels which bears the ovules. As only the morphological upper surface of the carpels can

carry ovules, one must assume that the outgrowth has reversed its orientation and that its morphological upper surface is turned outwards.

The paracorolla of the 'fertile double' plants shows very clearly that such an outgrowth may occur. The additional corolla-lobes have an inverse orientation, their upper surface being turned towards the outside of the flower. Their development starts rather late. The first sign is the appearance of a kidney-shaped primordium between the stamen and the petal lobe. In the early stages both of its surfaces look alike. The central bundle of the petal sends branches to the accessory lobe without change of orientation, while the branches from side bundles make a turn of 90° . Except for the fact that the outgrowth of the carpels does not receive bundles at all, both the paracorolla in the 'fertile double' and the outgrowth of the carpels are quite similar.

The axillary nature of the middle portion of the placenta is shown by its ability to continue growth, as found in 'claw' and in the abnormal *P. kewensis*. In the former the development is very irregular and the placenta is replaced by various structures growing out of a placenta-like primordium. The innervation of the placental region is still normal, while the further course of the bundles is very much altered. Sometimes the placenta may be transformed into a new growing point, producing a flower spike with normal flowers in the axils of bracts. Ovules may or may not be formed on a more normal portion of the placenta near the base.

The development in the abnormal *P. kewensis* is much more regular and may follow two courses. In both cases we find in young buds a normal placenta covered with normal anatropous ovules nearly up to its top. Later a growing point may clearly be seen at the tip, and this may produce either a secondary spike with many complete flowers each in the axil of a bract, or only one terminal flower may be formed which is always without a calyx. The upper edge of the placenta forms, just underneath the new corolla, a short collar which represents the calyx. The formation of another incomplete flower is repeated at the tip of the placenta of each of the subsequent flowers. The maximum so far observed has been four, each on the tip of the placenta of the preceding flower. No exception to the following rule has been observed: flowers in the axils of bracts are always complete, flowers at the tip of the placenta and not in the axil of a leaf are always without a calyx. In the latter apparently the calyx is represented by the preceding leaf-whorl, i.e. the carpels, or more correctly their outgrowth, which covers the axillary part of the placenta. No physiological explanation can be given for this peculiarity, which may be well in agreement with conceptions of an idealistic morphology.

The first 'pistilloid' plant of *Primula sinensis* examined appeared in an F_2 from seeds treated by X-rays by the late Mr. L. H. A. Stone. The new mutant was then crossed to unrelated plants and more recessive 'pistilloids' segregated in the F_2 from these crosses.

It was first believed that the typical feature of the new mutant was the transformation of the stamens into structures somewhat similar to an ovary and forming one or more stigmas. The plants grown this year, however, showed a very wide range of variation both towards a more normal formation and in the direction of increased abnormality. The only parts never affected are the outer leaf-whorl, the calyx and the innermost part of the flower, the placenta.

The primordia for calyx and placenta respectively are formed in both normal and pistilloid flowers well before and well after the other flower organs. The petals, stamens and the ovary wall are normally formed in the following way:—First five primordia appear just above the calyx, which soon fuse into a ring. Some time later we see this ring divide into two portions, an outer zone, forming the primordia of the petals, and an inner zone, the primordia of the stamens. The latter are for a considerable period more advanced in development than the former. During this time the central part of the flower bud is flat. Then a new ring-zone just inside the stamens is formed—the ovary wall. In 'pistilloid' flowers the primordia for these three leaf-whorls arise simultaneously and are generally completely independent of each other. This difference in the structure of the bud seems to be the essential difference between normals and pistilloids. Slight changes in the formation of these primordia in the 'pistilloid' bud are apparently the causes for the astonishing variation found in the flowers of this mutant.

The further development of a typical 'pistilloid' flower is as follows: the 'petals' are transformed into a structure nearly or completely calyx-like. The 'stamens' are transformed into structures with a very short petiole and a leaf-blade which may have colour like a petal and which may form both pollen-sacks and ovules and intermediate structures. Ovules are never formed on the petiole, but only on the upper surface of the leafy part, generally on an outgrowth. The loculi, if formed, are on the outside, i.e. near the lower surface of the 'stamen'. The ovules are generally orthotropous when they are produced on an open surface of the 'stamen'. They are more or less anatropous if the 'stamen' is folded and the ovules are thus placed in a cavity. The ovary wall in such flowers is normal.

The abnormality of the stamens may be increased. They may fuse with or may even replace the ovary wall, or they may

form small accessory ovaries. The petals, being already calyx-like, cannot become more abnormal. The very young bud in such a case shows a united primordium for stamen and ovary wall and a separate one for the transformed petal.

In the more normal flowers the development of petals and stamens is correlated and both are in the same degree normal or abnormal. In such a case the young bud also becomes more normal, and petioles and stamens develop from one common primordium. Sometimes the petals are almost normal and the stamens, which are inserted at the end of the corolla tube, show only stigma-like prolongations at the end of the filament.

It is difficult to explain the developmental mechanics of the normal flower in general, and to explain why some regions form different organs from other zones. One may assume that special 'hormones' or 'Wuchstoffe' in the sense of J. Sachs may be formed, and that the growing point of the flower bud is divided into concentric regions with the 'hormones' for 'calyx', for petals plus stamens and for carpels. Such an assumption would explain the development of 'pistilloid' flowers, where the primordia for the petal-stamens are split into two, one being pushed more outside and one more inside. Thus the 'petals' develop more or less in the 'calyx-region' of the bud into calyx-like structures and the stamens are shifted towards the 'carpel region' and correspondingly transformed.

Dr. A. B. RENDLE commented on the interest of Dr. Brieger's studies, especially of some of the abnormal flowers. The succession of flowers developed vertically in the centre of the flower of *Primula kewensis* was a convincing demonstration of the axial nature of the structures bearing the placentas. The examples cited of pistillody of the stamens were of special interest, as was also the suggestion that the diversion of the path of the hormones due to displacement of the primordia at the growing point was the cause of the malformations.

Dr. HAMSHAW THOMAS said that the observations which had been presented to the Society were of considerable interest and importance. He thought, however, that great danger attended the attempts to draw morphological conclusions from the study of abnormal flowers, because so little was known about the factors responsible for their appearance. It was thus all the more useful to obtain information about the developmental stages of the *Primula* flowers described, especially if it could be linked with knowledge of the genetical constitution of the plants concerned. The occurrence of different forms of flowers on the same plant seemed to show that the development of a particular abnormality could not

be ascribed to the possession of special genes, though the genetic constitution of certain plants probably led to the variability of developmental sequence of the floral primordia. Given unstable plants of this kind, valuable results would accrue if it were possible to make an experimental study of the relations between the appearance of abnormal flowers and the external or internal conditions during their development. If we could only ascertain the mechanism which governed the growth of similar primordia into stamens, petal-like bodies or carpel-like bodies it might then be possible to use abnormalities in the study of floral morphology.

Dr. T. A. SPRAGUE also spoke ; and Dr. BRIEGER replied.

The following paper was read in title :—

‘A revision of the genus *Pariana* (Gramineae).’ By
T. G. TUTIN, M.A. (Communicated by the BOTANICAL
SECRETARY.)

9 MAY 1935

Dr. W. T. CALMAN, F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 25 April 1935, having been circulated, were taken as read and confirmed.

A letter from the Secretary of State for Home Affairs was read, conveying the thanks of HIS MAJESTY THE KING for the Loyal Address from The Linnean Society of London.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Cyril Francis Hill and Francis Colville Minns ; for the first time, in favour of Cicely Kate Richardo.

The President reported the death of John Milton Offord, who had been a candidate for election for Fellowship at the present meeting.

The following candidates, whose names were read for the third time, were balloted for and elected Fellows :—Zafar

Alam, B.Sc., Joseph Ivan Armstrong, D.Sc., Edward Phillips Turner, Florence Hannah Bacon Marsh, Ruby Elaine Dowling, M.Sc., Samuel Edward Wilson, M.Sc., Ph.D., and Wilfred Ernest Watson Baker.

The following candidates for Foreign Membership were balloted for and elected :—Albert Francis Blakeslee, Ph.D., Christen Raunkiær, D.phil., Pierre-Auguste-Clément Dangeard and Gustav Senn, Dr. phil.

The following candidates for Associateship were balloted for and elected :—Arthur Augustine Dallman and Arthur Patterson.

Experiment with chestnut twigs. (Exhibit.)

By Miss HARRIET K. JAMES.

THE Botanical Secretary exhibited chestnut twigs which had been kept for two seasons in a glass vase containing rain-water in a sunny window glazed with Vita glass. Three twigs were used in the experiment. When cut on 5 March 1934 each had a well-developed terminal bud with two somewhat smaller lateral buds. By 18 March the terminal buds began to unfold, and by the 25th one of the stems had grown 4 cm., though there had been frosts during the week. Growth proceeded normally. At the end of July two of the twigs showed interesting developments, for new buds had arisen at the top of two of the twigs. In one twig it was well developed and 1 cm. long, and the new growth of the stem (5 cm.) was hard and woody though still green and covered with fluff. The new bud on the other twig was minute and very near the site of the original terminal bud, for, although normal leaves had been formed, stem-growth was only 1 cm. The twigs were kept during the winter and the water renewed from time to time. The twig which had not developed a terminal bud the previous year showed no sign of life. The terminal buds of the others became sticky in March and developed normally, the larger one producing three pairs of leaves and the other two.

The Botanical Secretary commented on the unlooked for results obtained by keeping twigs so much longer than was the custom. In reply to the President he said that no food beyond the small amount of mineral salts in rain-water had been supplied. Presumably the growth had taken place at the expense of food material present in the tissues. Miss James intended to continue the experiment another year and it would be interesting to find out whether the new leaves were able to form enough food for further growth. It was

worthy of mention, perhaps, that the twig which did not develop a second year produced by far the finest leaves and made the longest growth of new stem.

The President thanked Miss James for her interesting exhibit and the Botanical Secretary for presenting it.

A new race of Wild Ass from the Sudan, *Asinus asinus diana*e, subsp. nov. By Capt. J. GUY DOLLMAN.

Two well-marked races of Wild Ass have hitherto been recognized, the Nubian Wild Ass, *Asinus asinus africanus* Fitzinger, from Sennaar and Nubia, and the Somali Wild Ass, *Asinus asinus somaliensis* (Noack), from Somaliland. A third race, *Asinus asinus taeniopus* Heuglin, has been described from the Hawash District of Abyssinia; this latter would appear to be more nearly related to the Somali Wild Ass than to the Nubian form.

The Somali Wild Ass is a larger animal than the Nubian, standing about 4 feet 1 inch at the shoulder, whereas the Nubian race measures only about 3 feet 9½ inches to 3 feet 10 inches at the shoulder. Further, the colour of the two animals is very different, the Somali race being usually a stone-grey animal with a discontinuous and inconspicuous dark stripe down the middle of the back, whereas in the Nubian form the general colour of the coat is brownish buff above and the dorsal stripe is well-marked and continuous from the mane to the root of the tail. The shoulder-stripe in the Somali Ass is but little developed, and sometimes entirely absent; in the Nubian race the shoulder-stripe is well developed and broad and extends on to the withers as a conspicuous feature. The legs are barred for a considerable distance of their length in the Somali animal and there is a brown patch on each foot just above the hoof. In the Nubian Ass there are no traces of dark bars upon the legs, although there is a dark patch on each side of the front fetlocks. The mane in this latter animal is shorter, more erect and less black than it is in the Somali race, and the ears are rather longer and blacker on the tips.

In this new race from Hafta, in the Sudan, the general bodily size would appear to agree more with that of the Somali Ass than with the Nubian one, the two specimens available for examination, which are both females, measuring 47 inches and 46 inches at the shoulders. The larger of these two specimens has been mounted for exhibition in the Powell-Cotton Museum and appears to be nearly as large as a male specimen of *somaliensis* in the British Museum Collection. There can be but little doubt than an adult male specimen would be fully as large as the Somali animal.

The general colour of the coat in the mounted specimen is rather greyer than in the unmounted skin, resembling in this respect the Somali race. The second specimen, the unmounted skin, is rather redder, and would appear to resemble more the colour of the Nubian Ass. The dark dorsal stripe is present and conspicuous; it is continuous throughout its length, extending from the mane to the root of the tail, but is very narrow. The shoulder-stripe is well defined but is narrow and does not extend so far down the sides of the body as in *africanus*. The legs are practically devoid of dark stripes except faint traces of two narrow ill-defined bars situated just above the hoofs. The mane and ears resemble those of the Nubian Wild Ass more than the Somali one, in that the mane is shorter, erect, and brown, and the ears are longer and with darker tips.

The skull, compared with that of the type of *somaliensis*, is considerably broader across the zygomatic and maxillary region; it is difficult, however, to know how much importance should be attached to this distinction, since the typical skull of *somaliensis* is that of a sub-adult individual. Compared with the skull of an old male specimen of the Nubian Wild Ass this new form would appear to have narrower and more acutely pointed nasals, rather broader maxillary region and broader teeth. Doubtless a full-grown male skull would considerably exceed in size the male of the Nubian race.

This new subspecies is founded on two specimens recently collected by Major P. H. G. Powell-Cotton and his daughter, Miss Diana Powell-Cotton, while on a shooting trip in the Red Sea Province of the Sudan. One specimen is an unmounted skin and skull in the British Museum Collection (No. 52) and the other is a mounted specimen and skull in the Powell-Cotton Museum, Birchington (No. 54). Major and Miss Powell-Cotton have presented the unmounted specimen to the British Museum, where it will be kept in the Study Collection. The mounted specimen will be on exhibition at the Powell-Cotton Museum.

Type-locality: Hafta Wadi (17° 43' N., 37° 36' E.), Red Sea Province, south of Tokar near the Eritrean boundary. Measurements of British Museum (No. 52) and Powell-Cotton Museum (No. 54) skulls respectively: greatest length 500, 522 mm.; greatest breadth 203, 208 mm.; tooth-row 159, 159 mm.; interorbital constriction 132, 142 mm.

It gives me great pleasure to name this new race of Wild Ass from the Red Sea Province after Miss Diana Powell-Cotton, who, in addition to shooting one of these two specimens, has also collected many other Sudanese and Somali game animals for the British and Powell-Cotton Museums.

Major P. H. G. POWELL-COTTON said:—It was during a shooting trip in the Red Sea Province of the Sudan, south of Tokar near the Eritrean boundary and in the neighbourhood of the Hafta Wadi ($17^{\circ} 43' \text{ N.}$, $37^{\circ} 36' \text{ E.}$), that my daughter and I located the Wild Ass.

Between 18 February and 2 March 1934 we saw the animals on four occasions, as follows, 1, 2, 2, 3, and secured the two specimens permitted us. Unfortunately both were female, although we had the second under observation for some time and the Arab hunter insisted that it was a male. Immediately after the shot an unmistakably larger ass showed itself.

Both beasts killed were in winter coat. The field measurements were respectively: height 47 and 46 inches; girth $53\frac{1}{2}$ and 55 inches; length in a straight line 70 and 71 inches.

The ground was stony and sterile, with the wadis deeply cut. A strong gusty north wind blew continuously, and made it most difficult to pitch the tent or to stand and fire without support.

The Arabs, who kill numbers of Ibex, leave the Wild Ass unmolested as they do not eat its flesh, and they told us they were more numerous across the Eritrean boundary.

Luminous shrimps of the genus *Sergestes*.

By Dr. ISABELLA GORDON.

THERE are two types of luminous decapod Crustacea: (a) those that possess certain glands which produce an oily substance that becomes luminous as soon as it comes into contact with the surrounding water, e.g. the deep-sea shrimp *Heterocarpus* and certain of the Eryonidae; (b) those that possess special luminous organs or photophores. The latter group includes most of the Euphausiacea, a few Hoplophorids and a few species of *Sergestes*, all pelagic or bathypelagic. The photophores have a rather different microscopical structure in, and have probably been independently acquired by, all three; a lens and a reflector is always present. In 1925 Dr. Kemp found luminous organs with apparently no lens in a few littoral Pandalids.

When, some years ago, Dr. A. Terao requested me to compare specimens of a luminous species of *Sergestes* from Japan with the *Challenger* type of *S. prehensilis* Bate I was able to confirm Hansen's statement that they were distinct. Further search in the literature revealed that in 1922 Hansen had renamed the species, referred to *S. prehensilis* by Nakazawa and other Japanese writers, *S. lucens*. I was quite surprised to find that the type-specimen of *S. prehensilis* was also luminous—all the more so as Hansen, the discoverer of photophores in the genus *Sergestes*, must have overlooked them when he re-examined the specimen in 1903.

The number and arrangement of the photophores differed so markedly in *S. lucens* and *S. prehensilis* that I decided to re-examine as many of the luminous species as possible. The results were a little disappointing, for the number and arrangement of the photophores is very similar in all species, *S. prehensilis* Bate (1888) and *S. gloriosus* Stebbing (1905) excepted. These two species prove to be identical, so that the latter becomes a synonym of the former. *S. lucens* differs from *S. challengerii* Hansen and *S. splendens* Hansen in having four lateral pairs of photophores near the bases of pereopods 2-5 instead of only two pairs near pereopods 4 and 5.

S. lucens is of considerable economic importance in Japan, where some ten million pounds are caught annually; in 1914-15 the industry yielded half a million yen.

Dr. Terao has described how the photophores function in living specimens; they emit a greenish yellow light and, as a rule, light up one by one in serial succession from the head backwards. Occasionally a small group will light up simultaneously and remain active for several seconds.

On two rare Crustacea Macrura.

By Dr. ISABELLA GORDON.

IN the past sixty years seven species of the genus *Anchistioides* Paulson (1877) have been described, mostly from one or two specimens; these species are probably not all valid. The genus proves to be fairly common at Bermuda, for in 1934 thirty-six specimens of *A. antiguensis* (Schmitt) were collected by F. A. Brown, Jr., between 7 and 17 June, an electric light being used at night to attract them. Since then Dr. R. Gurney obtained eighteen specimens (Feb.-Mar. 1935). It is not known where they live during the day, but they swarm at the surface more or less sporadically at night (9-11 p.m.). The genus is referred to the family Palaemonidae, subfamily Pontoniinae, not to the Crangonoida.

The genus *Euryrhynchus*, hitherto known only from four imperfect specimens from wells in Pará and Cayenne, was found in considerable numbers by Dr. G. S. Carter in the Manicole Swamp in British Guiana. These specimens agree with the fragmentary co-type of *E. wrzesniewskii* Miers (1877) in the British Museum Collection. Slides illustrating a number of morphological peculiarities, to be described in detail elsewhere, were shown. The most interesting features are (1) the eyes, with no definite line of demarcation between the small cornea and the stalk; (2) the peculiar accessory ramus of the outer antennular flagellum; (3) the uropods; (4) the much reduced pleopods, which exhibit an unusual degree of sexual dimorphism; (5) the presence of a peculiar type of spermatophore in many of the larger males; and (6) the greatly enlarged

pleura of abdominal somites 1 and 2, forming a brood-pouch completely surrounding the few very large ova.

Dr. G. S. CARTER contributed some remarks on the habitat of *Euryrhynchus* and the PRESIDENT thanked Dr. Gordon for her interesting communications.

Rhythmic development and radial organization in the flower.

By Miss E. R. SAUNDERS.

IT is well known that in a number of species it is difficult or impossible by mere inspection of the outward form to determine with certainty the number of members composing individual floral whorls. It is therefore highly desirable to find some criterion other than the external appearance which will enable us to arrive at a correct interpretation of the floral ground-plan. Such a criterion is afforded by the vascular ground-plan, since both ground-plans are expressions of the same morphological scheme in different terms.

The principle underlying the vascular ground-plan is that each member of each whorl receives at the exertion level a single median bundle, the midrib bundle. When more than one bundle enters the exerted member the additional bundles almost always represent laterals, either commissural in origin or resulting from branching of the midrib bundle below the exertion level. These midrib bundles, like the floral members which they serve, arise in whorls, the successive whorls turning out on alternate sets of radii.

These midrib bundles may turn out independently for each successive whorl, or those for two (or even three) superposed whorls may arise as a single whorl of trunk-cords which dissociate later into their components. This formation of a reduced number of trunk-cords in place of the full number of independently arising midrib bundles provides an alternative means whereby the limitations imposed upon cyclic types by the shortening of the floral axis can be met without reducing the number of members in the whorl. Among Monocotyledons in which the four outer whorls are isomerous the physical conditions have very generally been met by this alternative method, whereby a saving is effected in vertical space (or time). Among Dicotyledons coming under this head both methods are frequently found, often in conjunction.

When the midrib bundles of two superposed whorls are derived from one set of trunk-cords these two whorls behave as a unit whorl in the scheme of alternation. This is shown by the fact that in species in which two superposed whorls are served by a single set of trunk-cords the suppression of the inner of two such whorls has no effect upon the radial position of the succeeding whorl.

These differences in the mode of origin of the midrib bundles, whether directly from the central cylinder or from a trunk-cord which has already issued therefrom, offer an explanation of the various classes of cases where the principle of alternation appears to break down with one exception—that of obdiplostemony and antepetalous loculi in those types in which the midrib bundles for all the whorls arise independently. The departure from the general rule in such types is attributed to a condition of 'block' or 'congestion' which becomes set up after the development of the fourth whorl unless some special feature is present the effect of which is to afford more time and/or space for the development of the next whorl.

The light which is thrown upon the floral ground-plan by examination of the vascular ground-plan is illustrated in the full paper by reference to various genera belonging to Coriariaceae, Ranunculaceae, Cephalotaceae, Elatinaceae, Lythraceae, Melastomataceae, Caryophyllaceae, Stachyuraceae, Crassulaceae, Saxifragaceae, Ericaceae, Liliaceae, Commelinaceae, Rapateaceae, Flagellariaceae, Myacaceae, Hypericineae.

Dr. A. B. RENDLE said that the author had suggested a simple explanation of obdiplostemony, but it was dependent on the theory that there were two whorls of carpels, which was not universally accepted. Exigencies of space at the growing point undoubtedly influenced the arrangement of the members of the floral whorls, but to regard the course and development of the vascular bundles as determining that arrangement seemed to him to be working backwards.

Mr. S. GARSIDE said that it was difficult to understand how the carpels could exert such an influence on the position of stamens, as the stamen primordia are usually well formed before the carpels begin to develop.

In many species of *Oxalis* the obdiplostemonous flower has a small tooth (up to 1 mm. long) situated on the outside of the staminal tube and opposite each of the innermost stamens. These structures, although without vascular supply, appear to be staminodes, and represent the missing outer or third whorl.

In *Hypseocharis* (Oxalidaceae), according to the account given by Knuth (Eng. Prantl. Nat. Pfl. 19a, p. 25, 1931), there are fifteen stamens in three whorls.

Replying to comments by Dr. Rendle Miss SAUNDERS stated that it was held that the vascular tissue of a foliar member first became differentiated at the point of junction of member and axis, and thence developed upwards, keeping pace with the further growth of the member, and downwards until it made contact with the vascular system already in existence. The upward development in the exerted member

bore no relation to the radial position of the member. But the manner in which the vascular system of a floral whorl fitted on below to the pre-existing system of the shoot was of primary importance in connection with the radial relation of one whorl to another, as she had described in detail in the course of her remarks. In further reply to the view expressed by Mr. Garside that obdiplostemony associated with antepetalous loculi is preferably explained as resulting from the suppression of a third whorl of stamens, Miss Saunders said that in none of the cases dealt with was there any evidence that a third whorl of stamens had originally been present which had since become suppressed, and that the whole of the evidence which she had brought forward went to show that such a supposition was not only unfounded but superfluous, as the superposition of successive whorls, when it occurred, could be explained in the way she had outlined.

[In regard to Mr. Garside's statement that his view receives support from certain members of the Oxalidaceae I may add here the following observations:—Firstly, as regards *Hypseocharis*, which has fifteen stamens. Rémy, who discovered the first known species, describes the stamens as being uniseriate (Ann. Sci. nat., Bot., sér. 3, t. 8, p. 238, 1847). Bentham-Hooker's more accurate account states that they are sub-2-seriate (Gen. Pl. i, p. 276, 1862)—a description which also on other grounds must be taken to be correct, for Eichler states that the primordia of the corolla-stamens are split pair-wise ('Blüthendiagramme', ii, p. 303, 1878) and this fact is reaffirmed by Reiche (Die natürl. Pflanzenf. iii, 4, p. 17, 1896). It may be surmised that Knuth's 1931 "in 3 Reihen" (cited by Mr. Garside) was substituted, as a supposed improvement, for the 1930 "sub-3-seriata" ('Das Pflanzenreich', iv, 130, p. 427) merely on the general idea that fifteen stamens regularly arranged in a pentamerous flower will naturally arise as three successive whorls. This inference is borne out by the fact that in his original account of the genus (Engler's Bot. Jahrb. 41, pp. 170-74, 1909) Knuth cites without comment both Rémy's statement that the stamens are uniseriate (see above) and Baillon's view that *Hypseocharis* stands in the same relation to other Oxalidaceae as *Monsonia* (then including *Sarcocaulon*) to other Geraniaceae (Nat. Hist. v. p. 26, 1878), omitting at the same time any reference to Eichler's statement respecting bipartition. Now in neither of the above-mentioned geraniaceous genera do the fifteen stamens present arise in three successive alternating whorls, but, as in *Hypseocharis*, they result from deduplication of the antepetalous whorl as described by Payer, whose account Knuth himself cites in his article on Geraniaceae in 'Das Pflanzenreich' (iv, 129, p. 17, 1912), an arrangement which is indeed discernible in Knuth's own figure of *Hypseocharis*

(Die natürl. Pflanzenf., 2 Auflage, 19 a, p. 42, fig. 19, Q). I have been able to confirm this duplication both for *Sarco-caulon* ('Illustrations of Carpel Polymorphism.—VII', New Phytologist, 30, p. 102, 1931) and *Monsonia*. Also to establish that a similar splitting gives rise to the supposed three staminal whorls in some Sapotaceae (e.g. *Bassia latifolia* Roxb.). It thus becomes clear that in no type do we find three alternating isomerous stamen whorls in which the first and last stand in line with the sepals. Secondly, so far as those species of *Oxalis* are concerned which show a small tongue-like projection at the back of the filaments of the antesealous stamens, it seems probable, as conceived by Eichler (*loc. cit.*), Hallier (Beihefte z. Bot. Centralb. 39, 2, p. 166, 1923), and (apparently) Progel, whose description of the genus includes the phrase 'dente v. glandula dorsali auctis' (Mart. Fl. brasil. 12, 2, p. 475, 1877), these structures are comparable with the glandular structures accompanying the antepetalous stamens in other species. It may be noted, further, that a median dorsal outgrowth is met with in other genera, as, e.g. *Borago*, where it cannot be supposed that they represent the remnants of a lost antesealous whorl. Furthermore, the conception that these projections in *Oxalis* represent a lost stamen whorl would entail the supposition than an antepetalous stamen whorl could come to stand outside *two* antesealous stamen whorls.—E. R. S.]

The following papers were read in title :—

'On the biology of certain species of *Amauronematus* Kon. (Hymenoptera Symphyta).' By HERBERT W. MILES, M.Sc., Ph.D. (Communicated by Prof. H. GRAHAM CANNON, M.A., Sc.D., D.Sc.)

'The British Robertsonian Saxifrages.' By H. W. PUGSLEY, B.A.

The President announced that the title of his presidential address to be delivered on 24 May was 'The meaning of biological classification'.

24 May 1935

ANNIVERSARY MEETING

Dr. W. T. CALMAN, F.R.S., President,
in the Chair

The Proceedings of the previous meeting, held on Thursday, 9 May 1935, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted :—Florence Hannah Bacon Marsh, Zafar Alam, Samuel Edward Wilson, George Eric Howard Foxon, Thomas William Woodhead and Ruby Elaine Dowling.

A certificate of recommendation of the following candidate for Fellowship was read :—For the second time, in favour of Cicely Kate Ricardo.

The Treasurer presented his Financial Report and the Accounts of the Society, duly audited, for the year 1934-35. Questions were asked by Dr. G. P. Bidder and Mr. T. A. Dymes, to which the Treasurer replied. On a motion by Dr. G. P. BIDDER, seconded by Mr. A. D. COTTON, the Report and Statement of Accounts were adopted.

The Bye-Laws regulating the Election of Council and Officers having been read by the Assistant Secretary, the PRESIDENT declared the Ballot for Council and Officers to be open, and voting began. The Ballot for Council was closed at 5.30 p.m. and for Officers at 6.0 p.m.

The following candidates were balloted for and elected Fellows :—Cyril Francis Hill and Francis Colville Minns, B.A.

Meanwhile the Librarian and Assistant Secretary presented his Report as follows :—

LIST OF THE SOCIETY.—Since the last Anniversary Meeting the Society has lost forty-six members. The detailed statement is as follows :—

22 Fellows by death :—Edgar Beckett, Ethelbert Blatter, Leonard Cockayne, Sir Arthur R. F. Dorward, Otto Vernon Darbishire, George Francis Scott Elliot, John Fraser, George Fry, Sydney Turner Klein, Mary Jane Longstaff, Kenneth Kent Mackenzie, Sushil Kumar Mukerji, Robert Paulson, Philip Grafton Mole Rhodes, Robert Alexander Robertson, William Robinson, Robert Francis Scharff, Henry Harwood Smith, Rupert Vallentin, George Chapman Walton, Edward Berkeley Wilkinson, Ellen Ann Willmott.

4 Foreign Members by death :—Nathaniel Lord Britton, Hugo de Vries, Charles Henri Marie Flahault, Henri Lecomte.

2 Associates by death :—Nicholas E. Brown, James Lomax.

14 Fellows by withdrawal :—Harriet Isabel Adams, Tribhawan Nath Bhan, Philip James Barraud, Joseph Bunny, Ernest St. John Burton, Richard Elmhirst, Robert Benson Ewbank, Robert McGillivray, Arthur John Maslen, Rowland Edgar Nicholas, Marion Beatrice Payne, Guy Coburn Robson, Sir Alexander Rodger, Robin John Tillyard.

4 Fellows by removal :—Harry Howard Allan, James Digby Firth, Syed Hedayetullah, Abdus Sattar.

During the Session 4 Foreign Members, 2 Associates and 35 Fellows have been elected. Of the 35 Fellows elected, 30 have qualified. A further 5 Fellows have qualified who were elected during the Session 1933-4.

The present number on the List of Fellows is 732, with 5 Fellows elected, but not yet qualified.

LIBRARY.—Between 1 May 1934 and 30 April 1935 21 books have been purchased and 20 books, 327 parts of periodical publications, and 164 reprints have been presented. During the same period the number of volumes bound was 268. The number of volumes borrowed by Fellows and Associates was 1,022, and by the National Central Library 208. On the other hand, 29 volumes were borrowed from the Science Library for the use of Fellows. 763 signatures were recorded in the Library Visitors' book, exclusive of 67 for Saturday afternoons.

An interesting collection of about 100 letters and 28 portraits mainly relating to American botany, together with Wedgwood medallions of Linnaeus and Sir William J. Hooker, has been added to the Society's archives by means of a subscription raised by the Fellows. This collection contains items of much historic interest.

LINNAEAN COLLECTIONS.—Between 24 May 1934 and 23 May 1935 the Herbarium has been consulted 37 times by visitors, who have examined 134 genera; the zoological collections have been consulted 13 times. In July 1934 Madame Beskow and her son and daughter, descendants of Linnaeus, visited the Society and fully examined the Collections.

At the conclusion of the Assistant Secretary's report the PRESIDENT appointed Mr. C. D. Soar, Mr. A. W. Sheppard and Mr. T. A. Dymes as Scrutineers of the Ballot.

In handing the Linnean Gold Medal to Sir DAVID PRAIN, C.M.G., C.I.E., F.R.S., the PRESIDENT addressed him in the following words :—

Sir DAVID PRAIN, It is a peculiar pleasure to me to present

to you on behalf of the Linnean Society its highest award, the Linnean Gold Medal.

It is customary on such an occasion, as you very well know, to make some statement as to the reasons which have decided the Council in making its choice of the Medallist. There can be no Fellow of the Linnean Society, however, even among Zoologists, who is unaware of the merits of our former President, and it is not therefore necessary for me to be more than very brief on this subject.

We know that you began your scientific work as a member of that great service which has produced so many eminent naturalists—the Indian Medical Service—that you became the head of Indian Botany when you were Director of the Botanical Survey of India and Superintendent of the Royal Botanic Gardens, Calcutta. You returned here to become Director of the Royal Botanic Gardens at Kew, an office which you filled with conspicuous success until your retirement in 1922. For you, however, retirement by no means meant idleness, and it would take a long time to enumerate the various honorary offices, such as that of Treasurer to the Royal Society and Trustee of the British Museum, which you have held or still hold. But although your success as an administrator has been conspicuous you have never forgotten that the business of a scientific man is scientific research, and your contributions to Systematic Botany, particularly that of the Indian Empire, are on a scale and of a kind that would have gladdened the heart of Linnaeus himself.

In many addresses, to some of which we have listened in these rooms, you have touched upon the historical and philosophical aspects of your subject in the spirit, if I may say so, of a scientific humanist, of a kind that increasing specialization is making rarer every day.

In handing you this Medal may I express the hope that your wide knowledge and your wise counsel will long continue to be, as they have always been, available for the help and instruction of the younger generations.

In reply, Sir DAVID PRAIN expressed his profound appreciation of the honour that had been conferred upon him.

In the introductory passage to his Address the PRESIDENT made the following statements :—

It has been the custom in this Society for your President to preface his Anniversary Address with a review of some of the main events in the history of the Society during the past year.

On this subject, however, it seems to me unnecessary

to take up more than a few moments of your time. The success of our meetings, which I think has not been less than in former years, has been due very largely to the labours of the two Honorary Secretaries most ably seconded by the Assistant Secretary. The Treasurer has again earned your gratitude by the unremitting attention he has given to our financial affairs.

Two reforms of more than usual interest have been initiated by your Council during the year. The first is a scheme of composition fees which, as the Treasurer has told you, will enable Fellows who wish to do so to compound for their future subscriptions. The second is that the Council, after careful consideration, have decided to modify somewhat the nature of our publication which is issued under the title of 'Proceedings'. It is intended in the next Session to begin issuing it in a slightly different format, and to utilize it for the publication of short papers which do not require numerous or elaborate illustrations. To ensure prompt publication of these the 'Proceedings' will in future be issued quarterly, and it is believed that they will meet a need which is at present not fully met by any of the publications of our Society.

You have just heard from the Assistant Secretary that the Society during the past year has suffered heavy losses by the death of many of its Fellows, Foreign Members and Associates. All of these will be suitably commemorated in the forthcoming number of the 'Proceedings' by hands far more competent than mine.

Looking down the list almost at random, however, one's eye is caught by names such as that of Dr. Leonard Cockayne, the pre-eminent New Zealand botanist, my old friend Dr. R. F. Scharff, formerly Keeper of the Natural History section of the National Museum in Dublin, Professor O. V. Darbishire, the well-known lichenologist, Professor Robert Alexander Robertson, to whom I owed much in the old days at St. Andrews, and Mr. William Robinson, whose 'English Flower Garden' has been in the hands of probably every gardener for more than a generation.

Of our Foreign Members we have lost Dr. N. L. Britton, Director of the New York Botanical Garden, after whom the great herbarium there has recently been renamed; Professor Flahault of Montpellier, whose methods of mapping plant communities, introduced into this country by my friend of long ago, Robert Smith, may be said to have begun the British school of Ecology; Professor Henri Lecomte of the Paris Museum; and then, only a day or two ago, Professor de Vries, our Gold Medallist in 1929, known to all the world by his mutation theory and by his part in the rediscovery of Mendel's work.

The PRESIDENT then delivered his Address, 'On the meaning of biological classification'.

On its conclusion, Sir SIDNEY F. HARMER, K.B.E., F.R.S., moved 'That the President be thanked for his excellent Address, and that he be requested to allow it to be printed and circulated amongst the Fellows'. The motion was seconded by Dr. A. B. RENDLE, F.R.S., and being put to the meeting was carried with acclamation.

The Scrutineers of the Ballot, who had retired at the appointed times with the voting-lists for the election of the Council and of the Officers, having completed their scrutiny, reported to the President, and he declared the result as follows :—

COUNCIL FOR 1935–36.—The Lord Aberconway, C.B.E.; Dr. Eric Ashby; Dr. B. Barnes; Dr. W. T. Calman, F.R.S.; Prof. G. D. Hale Carpenter, M.B.E.; Mr. Francis Druce; Mr. S. Garside; Dr. J. Hutchinson; Mr. H. A. Hyde; Dr. Stanley Kemp, F.R.S.; Dr. Margery Knight; Mr. Ashley G. Lowndes; Prof. E. W. MacBride, F.R.S.; Mr. John Ramsbottom, O.B.E.; Dr. Hugh Scott; Mr. D. J. Scourfield, I.S.O.; Lt.-Col. R. B. Seymour Sewell, C.I.E., F.R.S.; Prof. Macgregor Skene; Mr. W. H. Wilkins; Dr. E. B. Worthington.

(The retiring Councillors were Dr. S. E. Chandler, Prof. J. Stanley Gardiner, F.R.S., Mr. N. B. Kinnear, Dr. H. Hamshaw Thomas, M.B.E., F.R.S., and Prof. F. E. Weiss, F.R.S.)

OFFICERS FOR 1935–1936.—*President*: Dr. William Thomas Calman, F.R.S.; *Treasurer*: Mr. Francis Druce; *Botanical Secretary*: Mr. John Ramsbottom, O.B.E.; *Zoological Secretary*: Dr. Stanley Kemp, F.R.S.

The PRESIDENT then announced that he appointed the following as the Vice-Presidents for 1935–36 :—Prof. G. D. Hale Carpenter, M.B.E., Mr. Francis Druce, Dr. Margery Knight and Prof. Macgregor Skene.

Thereafter the President declared the Session of 1934–35 closed.

PRESIDENTIAL ADDRESS.

By DR. W. T. CALMAN, C.B., F.R.S., P.L.S.

THE MEANING OF BIOLOGICAL CLASSIFICATION.

(With 5 Text-figures.)

IN a review that appeared in 'Nature' * a few months ago, the following words occur :—

'Taxonomy is not an end in itself. Indeed, it is merely a convenient method of cataloguing, and something apart from modern conceptions of science. . . . It is by itself analogous to stamp collecting and cataloguing—quite a good amusement but leading nowhere.'

The rest of the review is of no importance for our present purpose, but the quotation itself states in an uncompromising manner a point of view that is implied or expressed in much of the academic teaching of biology at the present time. It is an expression of opinion that Fellows of the Linnean Society cannot be expected to regard with sympathy, but, if it is indeed widely held, it is clearly desirable that we should make an effort to understand it, if only as a preliminary to its refutation.

It is to be observed, in the first place, that the statement is not merely an expression of impatience with the trivialities of specific discrimination on the part of those who are concerned with the broader aspects of biology. It is a definite assertion that biological classification is meaningless except as a more or less convenient device for filing herbarium sheets or arranging our animal specimens on shelves. It is implied that the search for a Natural System of classification is futile, because no Natural System exists.

It is possible that if we could cross-examine one of those who despise the work of the systematist, we might find him reluctant to go quite as far as this. We all, even the youngest of us, profess to accept the doctrine of evolution, if only as a convenient weapon with which to meet the fundamentalists, and we can hardly believe in evolution while denying altogether that, in Darwin's words, 'community of descent . . . is the bond which, though obscured by various degrees of modification, is partially revealed to us by our classifications' †. Darwin, indeed, saw clearly, as early as 1842 ‡, that 'the

* 'Nature', March 9, 1935, p. 384.

† 'Origin of Species', 6th ed. 1872, p. 365. By an obvious error 'observed' is printed as 'observed' in this and subsequent impressions of the 6th edition, including the 'new impression' of 1900 (p. 569). It has been corrected in the editions now current.

‡ 'Foundations of the Origin of Species', ed. by F. Darwin, 1909, p. 36.

natural system ought to be a genealogical one', and the idea was old even then. It is implicit in Buffon*, in 1766, and Lamarck seems to take it for granted. Why then must we abandon it, and what is to take its place?

In the eighties of last century a fresh direction was given to morphological thought by the rise of the new branch of biology to which Roux gave the name of 'Entwicklungsmechanik'. This was an attempt to explain structure in terms of forces acting during the life-history of the individual organism, and to replace the 'historical morphology' of the period immediately preceding it by a 'causal morphology'.

The profound influence which this school has exerted on biological thought is known to everyone. In the passage which I have just quoted from Darwin I omitted one clause. Darwin wrote: 'community of descent, the one known cause of close similarity in organic beings'. It is not too much to say that causal morphology has revealed other factors besides community of descent as responsible for some of these close similarities. In other words, it has not only proved the possibility, but also explained a method, of convergent evolution on a scale unsuspected in Darwin's time.

This physiological point of view has tended to concentrate attention on those features of organic form that can be demonstrated experimentally to originate as individual responses to the pressure of environment, or to be the inevitable outcome of 'laws of growth' that are the same for organisms in different lines of descent. It has tended to neglect features for which no such explanation can as yet be imagined.

Perhaps it may be worth while to illustrate this point by a very simple and familiar example. A porpoise is very like a fish (fig. 1). Each has the same streamlined shape, paddle-like limbs, expanded flattened tail, and so on. All these features can be 'explained' on the lines of the orthodox Darwinian theory as adaptations, which become necessary whenever progression is demanded at a speed in excess of a rate determined by the viscosity of the medium through which the animal moves. Streamlined bodies and stabilizing planes are commonplaces of design in submarines, racing cars, and airships. The horizontal flukes of the porpoise's tail, as compared with the vertical tail of the fish, may be, as John Ray† saw two hundred and fifty years ago, 'partly to facilitate the fish's ascent to the top of the water (to which he can immediately raise himself by a light jerk of his tail, thus placed) for the use of respiration, which is as necessary for him as for quadrupeds'.

* Hist. Nat. xiv, 1766, p. 358.

† 'Further Correspondence', edit. R. W. T. Gunther, Ray Society, 1928, p. 59.

The causal morphologist will approach the problem from a different side. For him, these features are not adaptations to, but the results of, rapid progression through a viscous medium. He will point out that a mass of inanimate plastic material, propelled through water, will be forced into a streamlined mould. I should not be surprised if he went further and demonstrated that when the speed exceeded the critical rate at which turbulent flow sets in, the eddies would meet

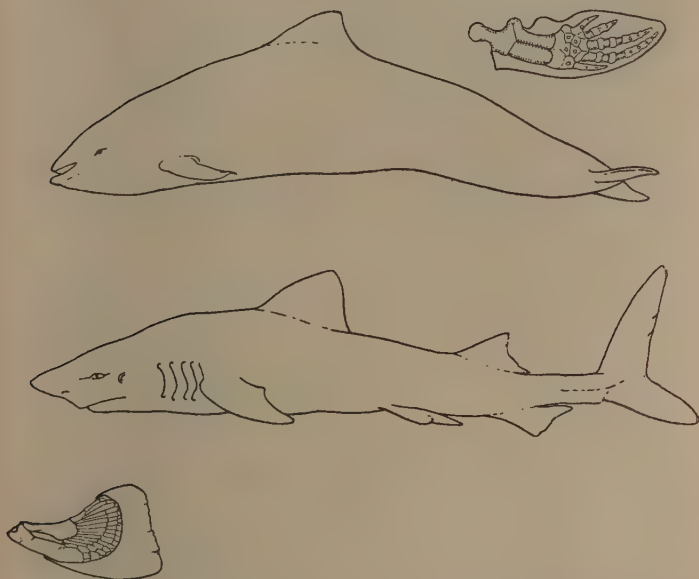


FIG. 1.—Outlines of a Porpoise (above) and of a Shark (below). The small figures represent the pectoral limb of each, dissected to show the skeleton. (From specimens exhibited in the British Museum (Nat. Hist.)).

just in the right place to stimulate the outgrowth of the dorsal fin. Roux*, in one of his earlier papers, did try to show that the form of the tail-fin of the porpoise, and the curves described by the interlacing fibres of connective

* Beitr. z. Morph. der funktionelle Anpassung.—“1. Struktur eines hochdifferenzierten bindgewebigen Organes (der Schwanzflosse des Delphin)”. Arch. Anat. Physiol. (Anat. Abt.) für 1883, pp. 76–162, pl. iv. Roux’s ‘Delphin’ was, in fact, a porpoise.

tissue of which it is built up, are the direct result of the strains and stresses set up by its movements through the water.

In either case, whether adaptive evolution or the direct action of environment has been at work, we have here 'close similarity of organic beings', which cannot be due to Darwin's 'one known cause', community of descent.

But no one disputes that the fish and the porpoise are fundamentally different. No one, so far as I know, attempts to explain as adaptive, or hopes to trace to morphogenetic causes, the skeleton of the porpoise's flipper, for example (fig. 1). Nothing but community of descent remains for us to fall back upon when we are faced with the fact that the flipper, unlike the fish's fin, retains the skeleton of the pentadactyle limb of a terrestrial mammal, crippled as it were by arthritis, with its immovable elbow joint, its radius and ulna incapable of rotation, its carpal bones dissolving into a continuous mass of cartilage, its fingers and thumb all firmly bound together. If Darwin's 'one known cause' no longer stands alone it still stands.

So far as I know, only one biologist in recent times has gone so far as to deny in so many words that community of descent has anything to do with similarity of structure. This is Prof. Przibram, whose theory of Apogenesis I have discussed elsewhere*. Most others seem to prefer to leave such problems aside, in the category of the unknown and unknowable, and to give their whole attention to matters that are accessible to experiment.

There is, however, one group of biologists who have never quite lost interest in questions of descent. Those who are concerned with the study of fossil animals and plants cannot, if they would, ignore the historical succession of organisms; nor can they altogether avoid speculating on the nature of the links that relate each form to those that precede and those that follow it in the geological time-scale. Here again we find that modern research has led to the recognition of many incontestable instances of parallel and of convergent evolution. I need not illustrate this by citing examples, for the subject was admirably expounded only a few years ago by one of the most erudite and philosophical of palæontologists, the late Dr. F. A. Bather†, in a presidential address to the Geological Society. His conclusions were that 'the whole of our system, from the great Phyla to the very unit cells, is riddled through and through with polyphyly and convergence', and, in regard to the main subject we are

* 'Presidential Address', Sect. D, Brit. Ass. Bristol, 1930.

† Q. J. Geol. Soc. lxxxiii, pt. ii, 1927.

considering here, 'Important though phylogeny is as a subject of study, it is not necessarily the most suitable basis of classification'.

When these words were uttered, they sounded to some of his hearers like a counsel of despair; and now that their author no longer abides our question, we are left doubting what other possible basis of classification he could have had to suggest to us.

It would be mere presumption on the part of one who is not a palæontologist to criticize on palæontological grounds the deductions of an acknowledged master in that science; but I must confess to a suspicion that things are not quite so bad as Dr. Bather painted them.

The number of instances in which the succession of fossils has been traced upwards through successive strata, foot by foot, with marvellous continuity, must not blind us to the fact that such instances are, in the nature of things, quite exceptional. Darwin's chapter on the Imperfection of the Geological Record is, on the whole, as applicable to the state of knowledge to-day as it was when it was written. Many of the phylogenies that have been based upon palæontological evidence are little less conjectural than those based on morphological evidence alone. The main difference (and, of course, a very important one) is that palæontological series can read only in one direction, while we are sometimes in doubt which end of a morphological series comes first.

When these considerations have been allowed for, however, we have to admit that palæontology has revealed instances of convergence that are beyond question, although they are far from proving it to be so all-pervading as Dr. Bather suggested.

It would be easy to multiply instances to show that convergence has been too lightly assumed by some phylogenists as an easy way of getting over difficulties; but, on the other hand, it is impossible to construct a reasonable scheme of phylogeny for any considerable group of organisms without finding it necessary to admit convergence in certain important characters.

Among plants I am told that this is conspicuously the case. In his recent book on 'Primitive Land Plants' (1935), Prof. Bower is very emphatic on this point. Speaking of the evolution of the Archegoniatae he says (p. 637), 'It should be realised that homoplasy has been a frequent phenomenon in evolution, while homology in the strict sense is less common than is usually supposed'.

As an example from the Animal Kingdom let us take the case of the Primates. The descent of Man has recently been the subject of much discussion, partly owing to the new

knowledge brought to light by palæontological discoveries, and a number of writers, particularly in this country and in America, have analysed the evidence bearing on the relations of the human stock with the other Primates and with the lower Orders of mammals. They arrive at results that are notably divergent, but all are agreed that it is impossible to construct any scheme of phylogeny for the Primates that does not imply the occurrence of parallel or convergent evolution on a large scale. The divergence between them resolves itself very largely into a difference of opinion, as to which characters can be supposed to have arisen independently in different lineages, and which are indications of common descent.

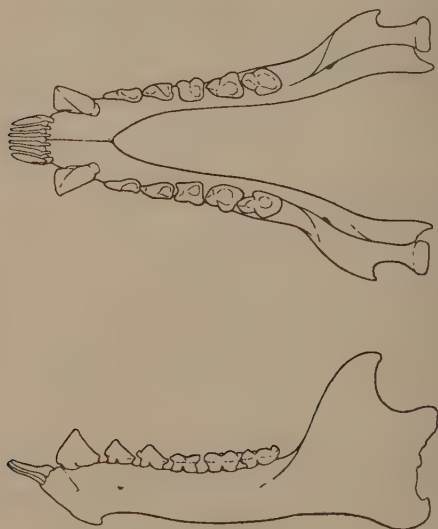


FIG. 2.—Lower jaw of *Lemur catta* (fam. Lemuridae), from above and from the side. Natural size.

Wood Jones *, who traces the human lineage to a Tarsioid origin independently of all the higher Primates, is led to assume the most far-reaching parallelism to account for the numerous resemblances between man and monkeys. Le Gros Clark †, who takes a more conservative view in deriving man from a Catarrhine stock, says, 'Many of the

* 'Man's Place among the Mammals', London, 1929.

† 'Early Forerunners of Man', London, 1934.

remarkable similarities in structure between man and the Gorilla (for example) must therefore owe their origin to an evolutionary parallelism which dates back to a phase not more advanced apparently than that reached by the Gibbons'.

Similarly, with the other divisions of the Primates. The Lemurs as a group are definable by an assemblage of characters that seem to be conclusive evidence of natural affinity; yet most recent authorities are agreed that the two main subdivisions of the group, the Lemuroids and the Lorisoids, must be traced back independently to a stage when many of these characters did not exist. Thus Regan * states that

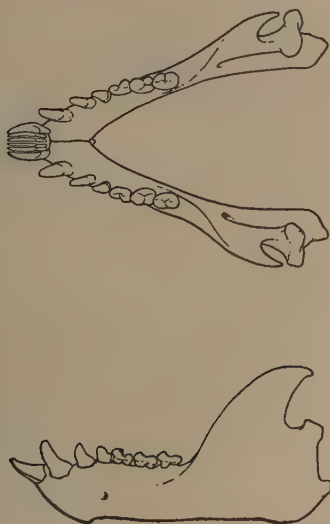


FIG. 3.—Lower jaw of *Perodicticus potto* (fam. Lorisidae), from above and from the side. Natural size.

'The Lorisidæ resemble the Lemuridæ in their dentition, having the lower incisors and canines slender and procumbent, forming a scraper, and the lower first premolar canine-like. This resemblance has been held by some authorities (e.g. Winge) to indicate a direct relationship between these families, but in my opinion it is due to parallel evolution' (cf. figs. 2 & 3).

The Old-World Monkeys are separated from those of the New World by profound differences of structure, so that the

* Ann. & Mag. Nat. Hist. (10) vi, 1930, p. 386.

two stocks must have separated very far back indeed; and yet the higher representatives of the two groups present similarities no less striking in features that cannot have been present in the common ancestor. To take only one example, the pattern of the cerebral convolutions in the New World Cebidæ is all but identical with that of the Old World Macacidæ (fig. 4); yet it seems certain that any imaginable common ancestor must have had a brain without any convolutions at all.

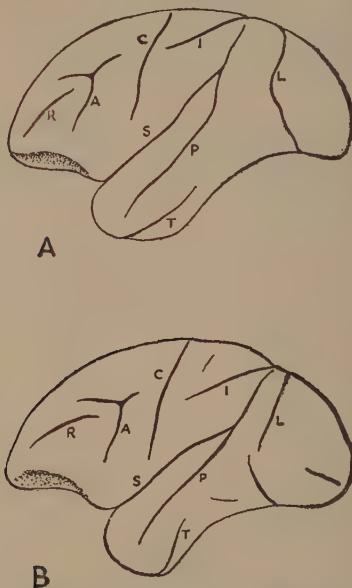


FIG. 4.—A. Cerebrum of *Cebus*. B. Cerebrum of *Macacus*.
(From Le Gros Clark, 'Early Forerunners of Man', by permission.)

Elliot Smith *, indeed, is moved, on one occasion, to protest that 'The fashionable and seriously overworked doctrine of convergence is a mere evasion of the real issue', but even he cannot get very far with the genealogy of man without having to call in its assistance.

When confronted with such examples of convergent, or, as Darwin called it, analogical resemblance, we are tempted to ask where we are to stop. Is structure ever an indication

* Proc. Zool. Soc. 1920, p. 471.

of phylogenetic affinity? Is community of descent ever a cause of organic similarity? Is blood ever, in fact, thicker than water? Dr. Bather, as we have seen, came near answering these questions in the negative.

Most morphologists have believed that, however exact the resemblance produced by convergence, investigation would always reveal the underlying evidence of descent. As Darwin* put it, 'In all such cases some fundamental difference in the growth or development of the parts, and generally in their matured structure, can be detected'.

We must, however, beware here of a very ancient type of fallacy:—

'Treason doth never prosper. What's the reason?

Why, if it prosper, none dare call it treason.'

Convergent evolution, if carried out to the end, would obliterate the evidence of its own existence. Can we believe that it never does so?

I do not profess to have any ready-made and conclusive answer to this question, but it seems to me that it might be helpful to approach it from another side—from the side, namely, of the pure systematist.

Throughout great sections of the Animal and Vegetable Kingdoms the broad outlines of a consistent and symmetrical Natural System have now been established beyond all possibility, as it seems, of question. It is true that there still remain very considerable assemblages of both animals and plants, of which the classification is still tentative and open to dispute. Since it is upon these debatable groupings that research and discussion have naturally concentrated, we may need sometimes to be reminded how extensive is the territory within which we no longer discuss the Natural Classification, because it has long ago been settled, taken for granted, and put out of mind. Just as, for many of us, fading memories of the Latin grammar consist mainly of lists of exceptions, lingering on after the rules themselves have been forgotten.

It is certain that a Natural System does exist. We may never be able to see all the details of its structure, and even its broad outlines may remain, here and there, a little blurred; but the general pattern cannot be mistaken. The framework of the 'Systema Naturæ' is something different in kind from the framework of the London Telephone Directory. It is an objective fact, not an arbitrary construction of human inventiveness. It calls for explanation as urgently as, for example, the Periodic classification of the elements; and no scientific

* 'Origin', 1900, p. 585.

explanation other than that offered by community of descent has ever been given.

If Dr. Bather and those who think with him were right; if the whole of the system were 'riddled through and through with polyphyly and convergence', then it is inconceivable to me that the resulting ruins would have presented anything resembling the coherent pattern that we observe in our approximations to the Natural Classification of animals and plants. As Darwin pointed out in the fourteenth chapter of the 'Origin', the categories of our classification cut across the categories of adaptation and those of environment. To suppose that they can be attributed to inherent laws of growth seems to verge upon mysticism.

I suggest, therefore, that the results of taxonomic research are, in their broad outlines, entirely inconsistent with the view that convergent evolution has been the rule rather than the exception in the phylogeny of animals and plants.

As an illustration, I would invite your attention for a little to the classification of the Higher Crustacea. The details of classification are apt to be dull and unattractive to anyone except a specialist, but I will try to be as brief as possible. I know of hardly any other group of animals where a classification based on purely morphological grounds can be so easily and naturally harmonized with a phylogenetic scheme, and while there is plenty of evidence that convergence has been at work, there is no evidence at all that it has played a dominant part in the evolution of the group.

The Crustacea that are grouped together in the Sub-class Malacostraca present a vast diversity of form and structure, and a no less striking variety of habits and habitats. At first sight the active, armoured shore-crab seems to have nothing in common with the shapeless, pulpy parasite that it harbours in its body-cavity. No two animals could well be more different in shape or habits than the graceful swimming prawn and the crawling woodlouse of our gardens. And yet it is easy to convince oneself that amid all this diversity a common plan of structure can be discerned so clearly that no one hesitates to regard the Malacostraca as a natural assemblage.

The chief characters that distinguish the Malacostraca from all the other sub-classes of Crustacea can be briefly stated. Apart from one exceptional group to be discussed presently, and from obvious instances of reduction, there are always fourteen body-segments behind the head and all of these may bear limbs. These limbs are invariably divided into two groups or 'tagmata', a thoracic group of eight pairs and an abdominal of six. The genital ducts in the male sex open on the eighth segment of the thorax, and, in the female, on the sixth.

Now it is, of course, conceivable that this assemblage of characters may have arisen more than once in the course of evolution of the Crustacea, but we may confidently assume that it is in the highest degree improbable. Their persistence through the widest possible range of habits forbids us to suppose that they are in any way adaptive. The mere coincidence in number of the body somites might, of course, be arrived at by some chance convergence, but we cannot conceive that either chance or adaptation would constantly place the male openings on the eighth somite and the female as constantly on the sixth. If structure is ever a guide to community of descent, the Malacostraca are a monophyletic group.

More than thirty years ago I pointed out * that the primitive members of several divergent groups of Malacostraca

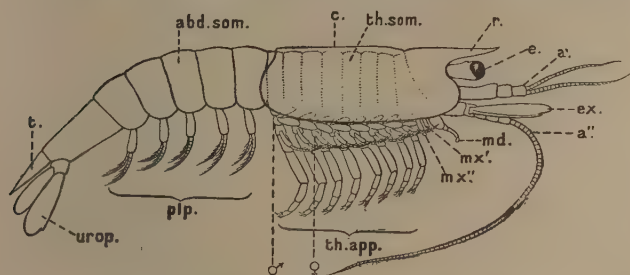


FIG. 5.—Diagram of a generalized type of Malacostraca, showing the 'caridoid facies'. (From 'Treatise on Zoology', ed. by Ray Lankester, pt. vii. fasc. 3.)

showed more or less clearly an approximation to what I called the 'caridoid facies', that is to say to a prawn-like form which is diagrammatically shown in fig. 5. In this type there is a carapace enveloping the thoracic somites, the eyes are set on movable stalks, the antennules are two-branched, the exopodite of the antennæ is a flattened plate, there are swimming-branches on the thoracic limbs, the abdomen is bent towards the ventral side, and the last pair of appendages have each two plate-like branches spread out on either side of the flattened telson to form the very characteristic 'tail-fan'.

Some of these features, particularly the stalked eyes and the carapace, are found in some of the other sub-classes of Crustacea. Others, without undue straining of probability, might be regarded as adaptive. The antennal scales may

* Ann. & Mag. Nat. Hist. (7) xiii, 1904, p. 147.

serve as stabilizing planes in swimming. The tail-fan and the ventral flexure of the abdomen are certainly used in making sudden backward leaps to escape from danger.

Now it is, again, conceivable that some or all of the features distinguishing this caridoid type may have arisen independently in unrelated lineages; but, although this is assumed, to some extent, in schemes of classification put forward, among others, by Giesbrecht and by Geoffrey Smith, we can say with confidence that there is no evidence of the whole assemblage having done so. Further, the derivation of all the Orders of Malacostraca from such a caridoid type is not inconsistent with the scanty help that palæontology affords us, for the earliest remains of undoubted Malacostraca come from the Coal-Measures, and they are all caridoid in general form, although in most cases we can say little more about them.

Before going on to discuss the derivation of the more familiar Orders of Malacostraca from the caridoid type, it is necessary to say something about the one group that appears to offer a real difficulty on this hypothesis. The little crustacean *Nebalia*, with its few living allies forming the Order Nebaliacea, was long regarded as a Branchiopod related to *Apus* and *Estheria*, although its earliest describers recognized its affinities with the Malacostraca. It differs in some very conspicuous features from all the other members of the latter group, though agreeing with them in the crucial points given by the number of the appendages, their division into two tagmata, and the positions of the genital openings in the two sexes. Perhaps the most significant of the differences concern the terminal part of the body. Although *Nebalia* has only the normal number of fourteen pairs of limbs behind the head, it has fifteen somites, the additional somite in front of the telson being without appendages. The last pair of appendages are not enlarged and do not form a tail-fan. In its place, however, the telson itself has a pair of rod-like appendages projecting backwards, forming a caudal furca such as is possessed by many Crustacea belonging to other sub-classes, but by no other Malacostraca in the adult state.

The suggestion of an affinity between the Nebaliacea and the Branchiopoda was based on the flattened leaf-like form of the thoracic limbs and on the bivalved shape of the greatly enlarged carapace, the two halves of which are drawn together by an adductor muscle, as in the Conchostraca among the Branchiopoda.

On closer examination, however, these resemblances fail to justify the assumption that they indicate real affinity. The leaf-like thoracic limbs have only a superficial resemblance to those of the Branchiopoda. In the genus *Paranebalia* the

limbs are long and slender, and not widely different from the biramous limbs of the caridoid type. The bivalved shape of the carapace does not amount to more than a lateral compression of the greatly developed shell-fold, and Dr. Manton * has recently demonstrated that the adductor muscle develops in a different somite from that of *Estheria*, so that the two cannot be regarded as homologous. We have here, in fact, a typical example of convergence, which does not conceal a fundamental difference of plan.

The peculiarities in the hinder region of the body that have been mentioned—the supernumerary somite, the absence of a tail-fan, and the presence of a caudal furca—are of more importance as indicative of a primitive position. Here again, however, the embryological work of Dr. Manton † throws light on the matter. She has shown that the fifteenth somite is present at an early stage in the development of Mysidacea, and that the somite in front of it grows backward, carrying its appendages to the position they finally occupy on either side of the telson. In the Mysidacea also it has long been known that the embryo possesses a caudal furca not essentially different from that of *Nebalia*.

It would not be difficult, then, to imagine the derivation of the Nebaliacea from the primitive caridoid type if we were at liberty to suppose that the fifteenth somite and the caudal furca were regained by the persistence of their embryonic state, and that the tail-fan regressed when its function was taken over by the furca.

On the other hand, the Nebaliacea may represent the survival of a pre-caridoid stage in which the tail-fan had not yet been acquired, and this view receives support from palæontology. The fossil Ceratiocaridæ and allied families, which are represented in Palæozoic rocks from the Cambrian upwards, resemble the Nebaliacea in general form, having a bivalved carapace and extended abdomen and also a movable rostral plate in front of the head. Unfortunately we have practically no information about the limbs of these fossil crustacea, and until further knowledge can be obtained their association with the existing Nebaliacea, though probably justified, is not beyond question. If it is accepted, we must carry the ancestry of the Malacostraca back to a pre-caridoid stage.

Leaving aside the Nebaliacea, the remaining Orders of Malacostraca can be derived, without any straining of probability, from the caridoid type. Two main lines of descent seem to be clear. On the one hand, we have the Peracaridan series, characterized by the possession, in the

* Phil. Trans. B, ccxxiii, 1934, p. 223.

† Phil. Trans. B, ccxvi, 1928, p. 404.

females, of a brood-pouch formed by overlapping scales attached to the bases of the thoracic legs. On the other hand, we have the Eucaridan series, without a brood-pouch, but clearly linked together by a number of positive characters while branching out in innumerable specializations of detail.

The first of these series, that of the Peracarida, shows, I think, as clear an example of a progressive lineage as we can find anywhere among recent animals. Starting from the Mysidacea or Opossum-shrimps, which still keep the primitive caridoid facies, we can follow the trend of evolution in a whole series of characters, the carapace gradually shrinking, the thoracic exopods dwindling and disappearing, the eye-stalks becoming fixed and sinking into the head, and so forth, through the Cumacea, Thermosbaenacea, and Tanaidacea, to the Isopoda. Each group has its own specializations, and in none do we find a single form that could stand as ancestor to the group next above; but within each group the seriation points back unmistakably towards such a form.

The Amphipoda, while clearly belonging to the Peracaridan series, stand apart from the rest and we cannot tell at what point they branched off. There is ground for believing that some of the characters which they have in common with the Isopoda, the sessile eyes and the coxal plates among others, may be due to convergence.

Time would fail me and I should only weary you if I were to trace out the ramifications of the other great series, the Eucarida, or of the two minor groups, the Syncarida and the Stomatopoda, whose relationships may perhaps become clearer when their palæontology is better known.

I hope that I have given you, however, some impression of the picture that unfolds itself to the systematist who studies the Malacostraca; of a natural classification that does violence to none of the conclusions of morphology or of palæontology, and that is consistent with an evolutionary history in which convergence may have played an important part but never the dominant one.

To know something of the course of evolution is a desirable preliminary to discussing the causes of evolution. If taxonomy can make a contribution towards our knowledge of the course of evolution, then it is a subject worthy of study. The anonymous, but surely very juvenile, reviewer whose words I quoted at the beginning of this address says that it leads nowhere. I am confident that you will disagree with him.

OBITUARIES

ETHELBERT BLATTER, S.J. (1877-1934).—Ethelbert Blatter died in Poona on 26 May 1934, and thereby India was bereft of one of its foremost botanists. An only son, he was born in December 1877 in the Swiss Canton of Appenzell. He lost his father in infancy, and grew up in his bachelor uncle's castle at Rebstein. After passing through several Swiss schools and colleges, where he invariably distinguished himself through brilliant scholarship, high spirits and an acute sense of boisterous fun, he decided, to the astonishment of all but his intimates, to devote himself to religious service, and in October 1896 entered upon the noviciate of the German Province of the Society of Jesus at the Austrian town of Feldkirch. His probationary studies and exercises were pursued at this place and in Holland in various seminaries, ending up at that of Valkenburg. At this last place he came into contact with several other inmates devoted to botany. This association led to his severing himself from classical and literary labours to return to his boyhood passion for the study of plant-life, which thereafter remained his first objective outside his religious life, in spite of the fact that he possessed high qualifications in other branches of natural history.

St. Xavier's College in Bombay sought for the services of a botanist, and the authorities of his Order decided that Blatter should occupy the post. He was sent for a few months first to Manresa House at Roehampton, whence he proceeded to Bombay towards the end of 1903. For the following five years Blatter taught botany and avidly embraced every opportunity for botanical excursions near and far. Not only did he thoroughly explore the surroundings of Bombay and of Khandala, one of the health resorts on the hills within easy reach of the presidency town, but he contrived tours in Kashmir, the Deccan and Ceylon.

In 1908 he returned to England, now a botanist of note, to complete his theological studies at Ore Place in Hastings, where he remained till 1913, having been ordained as priest in 1912. During this period all the time he could spare was given to botanical pursuits, and he soon found his way to Kew to start work towards his 'Flora Arabica'. At this time too he was admitted a Fellow of the Linnean Society of London. After a further year of probation in Holland he was back in England at the outbreak of the Great War. His superiors had decided to give him the best training in botany Europe could offer, but the advent of the war frustrated these plans, and for a time he was compelled to undertake priestly ministry. Owing to the shortage of teachers, however, he was sent back to Bombay in 1915 to resume his botanical work there, and he never left India again.

In 1919 the Principal of St. Xavier's College was appointed Archbishop and Blatter was selected to succeed him. This charge left him little leisure for botanical work, but presented the occasion for the display of other qualities in connection with educational work. He was nominated a fellow of the University of Bombay, and served on its syndicate as well as on other scholastic bodies. He inspected all the colleges and a multitude of schools, and had much to do with preparing the way for university and scholastic reform. Robbed of the freedom he had previously enjoyed, which gave him opportunity for exercise that his robust body demanded, subject to the relaxing climate of Bombay, Blatter's health broke down utterly, and in 1926 he was compelled to apply for the chaplaincy of Panchgani, a health resort in the range of hills east of Bombay. Here he arrived suffering severely from diabetes and dysentery. The more bracing climate and life in the open air restored some of his energy, and he was enabled once more to resume botanical pursuits. A mischance when out botanising, however, brought him to death's door, but his wonderful vitality pulled him through, and he so far recovered as to undertake a botanical expedition to Waziristan in 1930. In the course of this journey he met with a serious riding accident, which was probably the cause of a general collapse on his return.

Though Blatter recovered to a certain extent his strength had failed at last, and though he carried on it was only by painful effort and for short periods. Deprived of his power for work he no longer wished to live, and he gradually sank to a peaceful end.

In 1931 he was awarded the Brühl Memorial Medal by the Asiatic Society of Bengal for 'conspicuous important contributions to the knowledge of Asiatic Botany'. His output of published botanical work was prolific, the more important works being: 'The Flora of Aden', 'The Palms of British India and Ceylon', 'A Revision of the Flora of Bombay', 'A Bibliography of the Botany of British India and Ceylon', 'Flora Arabica', 'The Flora of the Indian Desert', 'Beautiful Flowers of Kashmere' and 'Flora of the Indus Delta'.

A very genial man, he was excellent company and delighted in telling the many humorous and quaint experiences of his life. A fitting conclusion to this note is the following quotation from the pen of one of his intimate friends:—

'Father Blatter was no ordinary man. His gifts were many and great, his acquired attainments remarkable, his achievements impressive. Few of his well-to-do friends guessed how charitable he was to the poor. Children loved him at sight; he was to them Father Xmas in flesh and bone.'

But the most surprising thing about him is, after all, that such a character should have become a Jesuit, submitted to stern rule, and lived and died a selfless priest who asked for no human reward and did not get any. The familiar of three Governors, the eminent botanist, the educationist of no mean standing died plain Father Blatter: as such he will be ever dear to those who were privileged to know so tender a soul lodged in such a ponderous body.' C. E. C. FISCHER.

NATHANIEL LORD BRITTON (1859-1934).—When Nathaniel Lord Britton died at his home in New York, 25 June 1934, at the age of seventy-five years, a life of exceptional botanical activity came to a close. Though he was trained first in geology and mining, as a young man he was soon led into that other field of science which was to occupy well over half a century of his life. To his initiative is due the establishment of the New York Botanical Garden. When he retired from its directorship in 1929 he continued his research work as avidly as ever, travelling, studying and writing continuously up to the time that his wife—herself a botanist of note—was stricken with a fatal illness only a few months before his own passing.

Doctor Britton was born at New Dorp, Staten Island, New York, 15 January 1859, a descendant of James Britton of London, England, who came to the American colonies in 1635. The old Britton home at New Dorp, acquired in 1695, was deeded by Doctor Britton in 1925 to the Staten Island Institute of Arts and Sciences, to be preserved as an illustration of early colonial architecture.

Educated at Columbia College, now Columbia University, Nathaniel Lord Britton was graduated from the School of Mines in 1879. Here he came under the influence of John S. Newberry, Professor of Geology and Mineralogy, and author of numerous papers on Paleobotany. After he was graduated he became Assistant in Geology under Professor Newberry, serving for the following five years as Botanist and Assistant Geologist on the Geological Survey of New Jersey. In 1881 he received the degree of Doctor of Philosophy from Columbia College. In 1886 his title was changed to Instructor in Geology and Botany in Columbia College, in 1890 to Adjunct Professor of Botany, and in 1891 to Professor of Botany, which he relinquished in 1896 when he was appointed Director-in-Chief of The New York Botanical Garden.

In these years he was industriously studying the flora of the eastern United States, and laying the foundation for the preparation of the 'Illustrated Flora of the Northern United States and Canada', which appeared in three volumes, 1896-98, under the joint authorship of N. L. Britton and Addison Brown, the first comprehensive illustrated flora for any part

of North America; a second edition appeared in 1913. Throughout his productive life he published extensively on the floras of North America, the West Indies and South America. Other outstanding botanical contributions include his 'Manual of the Flora of the Northern States and Canada' (1901, ed. 2, 1905, ed. 3, 1907), 'North American Trees' (1908, with J. A. Shafer), the 'Flora of Bermuda' (1918), 'The Bahama Flora' (1920, with C. F. Millspaugh), 'The Botany of Porto Rico and the Virgin Islands (Spermatophyta)', two volumes (1923-1930, with Percy Wilson). In 1901 his plan for the publication of the 'North American Flora' by The New York Botanical Garden was adopted. Seventy-five parts of this exhaustive work have been issued to date, and to these Doctor Britton made outstanding contributions. The geographic limits of this work comprise all of North America southward to Panama, including also Greenland and the West Indies. His *magnum opus*, prepared in association with J. N. Rose, is 'The Cactaceae', a four volume, copiously illustrated work published by the Carnegie Institution of Washington, 1919-23, in which 124 genera and about 1237 species are recognized and described in this monographic treatment of a perplexing group of plants. In connection with The New York Botanical Garden Doctor Britton established a notable series of botanical periodicals, consisting of the 'Bulletin', 'Contributions', 'Journal' and 'Memoirs' of that institution, and 'Mycologia' and 'Addisonia', in addition to the 'North American Flora' discussed above. The new periodical 'Brittonia' established two years after his retirement was named in his honour.

Great as Doctor Britton's contributions to the science of botany were in publications, his greatest achievement was the establishment and development of The New York Botanical Garden. Starting with the idea inspired by a remark made by Mrs. Britton while they were visiting the Royal Botanic Gardens at Kew in 1888, he saw the institution established less than ten years later, and directed its development from then until his retirement in 1929, when in his seventy-first year.

Mrs. Britton's remark was in effect 'Why couldn't we have something of this kind in New York'? On 24 October 1888 she gave her impression of Kew at a meeting of the Torrey Botanical Club in New York. At the next meeting of the club a special committee was appointed to consider the matter of the establishment of a Botanical Garden in the City of New York. At its meeting on 8 January 1889 an appeal for such a garden, prepared by the committee, was accepted. A little later the Department of Parks conditionally approved the establishment of such an institution. A special Act of

the New York Legislature, approved 28 April 1891, created the corporation known as 'The New York Botanical Garden', its objective being the establishment and maintenance of a Botanical Garden in the City of New York. The list of forty-eight names of the incorporators included such well known New York citizens as Seth Low, Charles A. Dana, Cornelius Vanderbilt, J. Pierpont Morgan, Andrew Carnegie, Morris K. Jessup and D. O. Mills. The Act authorized and directed the Park Commissioners of the City of New York to set aside an area not exceeding 250 acres in some park north of the Harlem River if, within seven years, the corporation should secure by subscription not less than \$250,000 to serve as the nucleus of an endowment fund. By 18 June 1895 the required amount had been raised by subscription. The Park Commission was then asked to set aside 250 acres of land in Bronx Park (increased to nearly 400 acres in 1915) and to appropriate \$500,000 for suitable buildings as required by the legislative enactment. The year 1900 saw the completion of the museum building and eight houses of the main conservatory. A Board of Managers had been elected in 1895, and a little later an agreement was made with Columbia University whereby the botanical library and herbarium of the University were to be deposited at the Botanical Garden, and the facilities of the garden were to be placed at the disposal of the staff and advanced students of botany in the University.

In its organization The New York Botanical Garden is a quasi-city institution, like the Metropolitan Museum of Art, the American Museum of Natural History, the Zoölogical Park and The New York Public Library—that is, supported in part by city appropriations and in part by private funds, gifts, membership fees, income from endowments and other sources. Like the institutions named it is a corporation with its own board of managers, and is thus to a degree independent of city control.

In all of the preliminary work Doctor Britton took a leading part. He was naturally selected to direct the enterprise, and was appointed Director-in-Chief on 17 June 1896. To him more than to any other individual is due the credit of making the dream of a few an existing reality. Within a period of thirty-five years to build up from raw unimproved land a great botanical garden, the largest institution of its kind in America, and one of the great botanical gardens of the world; with the essential buildings and conservatories; a library of about 43,500 bound volumes and several times as many unbound pamphlets; reference collections approximating 1,700,000 herbarium specimens; extensive collections of hardy and tender cultivated plants; a supporting membership of nearly

2,000 individuals; an endowment of about \$2,500,000; to institute vigorous and continued exploration, research and publication projects; and to meet the numerous administrative problems unavoidably associated with such a project, political, social, economic and scientific in nature—these serve to indicate the breadth of vision, driving force, administrative and scientific ability of Doctor Britton. And yet the establishment of the New York Botanical Garden was never more than a means to an end with him, for always first and foremost with him was scientific research and the publication of the results obtained. It is often said that The New York Botanical Garden is a monument to the energy, wisdom, scientific attainments, organization and administrative ability of Nathaniel Lord Britton, and of him it may truly be said *Si monumentum requiris, circumspice*.

Doctor Britton's interests were by no means confined to The New York Botanical Garden, although he freely gave from his private income to its support. He was the leading spirit in the organization of the 'Scientific Survey of Porto Rico and the Virgin Islands' under the auspices of the New York Academy of Sciences. He was a keen supporter of the Staten Island Institute of Arts and Sciences (of which he was one of the organizers), the Torrey Botanical Club, and the New York Academy of Sciences. Doctor Britton remembered all of these organizations, as well as The New York Botanical Garden and Columbia University, in his last will. In bequeathing to them, in varying amounts, one-half of his estate he materially assisted the future development of research and publication in the fields in which he was personally interested.

Doctor Britton was the recipient of many honours, including membership in the National Academy of Sciences, American Philosophical Society and the American Academy of Arts and Sciences. He was elected a Foreign Member of the Linnean Society 7 May 1925. He served as President of the Botanical Society of America, two terms, the New York Academy of Sciences, two terms, and the New York State Forestry Association.

Although slight in build and apparently of frail physique Doctor Britton was a man of very great energy, a persistent worker and an individual of pronounced ideas. In the nomenclatural controversies of the last decade of the preceding century and the first decades of the present one he was an outstanding champion of strict priority in publication and an outstanding exponent of the so-called 'American' code of Botanical Nomenclature as contrasted with the International Rules. As a result his own publications were issued under the American Code, and most or all of the official

publications of The New York Botanical Garden under his administration were naturally issued under the same code. Many botanists frankly admit that certain provisions of the 'American' Code were superior to the original provisions of the International Code, and the adoption of some of the more important of these provisions in the form of amendments to the International Code by the Cambridge International Botanical Congress of 1930 brought the two codes into approximate agreement except on the one question of conserved generic names of the latter code.

While Doctor Britton would be considered conservative in the matter of delimiting species he was distinctly not conservative in his concept of generic limits, tending to separate genera on what many botanists consider to be very slight characters. Essentially, genera and species being subjective concepts, no such thing as legislative authority as to what shall constitute the limits of a genus or a species is possible, as noted by Dr. M. A. Howe * in his appreciative biographical sketch of Dr. Britton, from which many of the data in this notice are taken. This will remain a matter of personal opinion, and in the Brittonian generic concept some botanists will agree and some will disagree.

In his many outstanding accomplishments Doctor Britton was always a man of strong convictions, and never hesitating to express his ideas no matter whether others might be expected to agree with him or not. His work left a deep impression on American botany, a subject with which his name will be associated as long as botanical science exists.

E. D. MERRILL.

NICHOLAS EDWARD BROWN.—Dr. N. E. Brown was born at Redhill, Surrey, on 11 July 1849. He died peacefully on 25 November 1934 at his residence at Kew, after a few months' illness, and was buried at Richmond Cemetery on 29 November.

Brown was educated at the Grammar School at Reigate, and on leaving was employed by Mr. William Wilson Saunders, F.R.S., F.L.S., as Curator of his museum in the same town. Mr. Saunders was a keen horticulturist, and he produced and edited the 'Refugium Botanicum'. This ran into five volumes, from 1869-1873, and was devoted chiefly to succulent and bulbous plants, Orchids, Aroids, Bromeliads etc., families in which Brown retained a great interest to the end of his life. Contributors to the magazine were Mr. J. G. Baker and Professor H. G. Reichenbach, of Hamburg, whilst the drawings were done by Mr. W. H. Fitch. Thus Brown was

* Journ. N.Y. Bot. Gard. xxxv. pp. 169-180, portrait, 1934.

closely associated with the leading botanists of that time, for Reichenbach used to speak of him as his 'lynx-eyed little friend', an apt description, as Brown had indeed the eye of a botanical Sherlock Holmes.

Brown became a colleague of Mr. Baker at Kew in 1873, and in 1874 he commenced lecturing on geographical botany to the student gardeners. Horticulture benefited greatly by Brown's work; he had a hand in Hogg's 'Gardeners' Year Book', and assisted in compiling Johnson's 'Gardeners' Dictionary', and during the whole of his life was a valued contributor to the 'Gardeners' Chronicle'.

Brown's contributions to botany were many and varied. British botanists will remember him as having completed the last volume (vol. 12) of Syme's 'English Botany', some of the plates by himself, and he published a supplement to vols. 1-4 in 1892. He soon became intensely interested in the flora of Africa, and he knew the geography of that continent better than anyone through editing the records of the 'Flora of Tropical Africa' and 'Flora Capensis'. He worked out many families for these works and he helped largely in their completion. He was regarded as the first authority on succulent plants and on such difficult families as Asclepiadaceae and Araceae and the genera *Euphorbia*, *Sansevieria* etc., his dissertations on these being regarded as models of critical work. In addition to many other papers he wrote the account of the plants collected on the Mt. Roraima expedition (Trans. Linn. Soc., ser. 2, vi., 18-107, with 14 plates).

Of late years and since his retirement Brown made a critical study of the large and unwieldy genus *Mesembryanthemum*, and discovered in that quite a family of smaller genera. The results were published mainly in the 'Gardeners' Chronicle' and, in collaboration with Fischer and Karsten, in a book entitled 'Mesembryanthema' (L. Reeve & Co., 1931). He also assisted Dr. Burt Davy with portions of the 'Flora of the Transvaal', and studied especially the Iridaceae.

Besides being a systematic botanist of the first rank, and known the world over, Brown was a keen microscopist, and in his 'spare time', studied Diatoms. In 1933, when 84 years of age, he published a small book containing an account of *Arachnoidiscus*, consisting of 88 pages and 7 plates (W. Watson & Sons, Ltd., London).

Although he seemed something of a recluse Brown was a jolly little man and loved to 'crack a joke', and he was particularly fond of dancing. He was promoted to be Assistant Keeper of the Kew Herbarium in 1909, elected an Associate of the Linnean Society in 1879, and in 1921 was

awarded the Captain Scott Memorial Medal by the South African Biological Society. In 1932 the University of the Witwatersrand conferred on him the honorary degree of Doctor of Science.

Brown was the last of the old brigade of Kew botanists who were associated with Bentham and Hooker and their contemporaries, and we of the younger generation miss him very much, for he was always ready to help us from his vast experience of herbarium work, and he was never appealed to in vain.

J. HUTCHINSON.

LEONARD COCKAYNE (1855-1934).—Born at Thorpe House, Norton Lees, on 7 April Leonard Cockayne early evinced a love for the plant-life of his Derbyshire hedgerows, meadows and woodlands, and showed the zest for gardening that remained his greatest joy throughout a full and energetic life. It was always from nature that he learnt rather than from his books and class-room studies. Nor was the poet in him ever quite quenched by the scientist. All life was full of values to him, from these early formative days to the end.

In 1876 he went to Australia, and after teaching for some years there and in New Zealand he began farming near Christchurch. But the call of the garden was insistent, and he soon settled down near New Brighton, a seaside suburb of Christchurch, there on the sandy soil to give his whole attention to horticulture, allowing full rein to his passion for daffodils. Eager for the forest and mountain he collected widely, and soon assembled a remarkable series of New Zealand plants. In all his travels he collected seeds, and early on entered upon an exchange with botanic gardens in practically all European countries, in South Africa, Ceylon, the Philippines, Hawaii, Java, Japan, the United States and Canada. The list of his correspondents mounted rapidly, and soon he was receiving letters from botanists the world over. To the end of his life 'foreign-mail day' was a day of greatest excitement in his home. This correspondence naturally turned his thoughts ever to the more strictly botanical aspects of plant-life, and also gave him many close friendships. Among those who most influenced him, and encouraged his bent for experimental and ecological work, it will not be invidious to mention the late Sir Joseph Hooker, the late Karl Ritter von Goebel, the late Professor A. F. Schimper, the late Dr. J. P. Lotsy and Professors L. Diels and C. Schröter. Later came visits to New Zealand from botanists of other countries, and of these he looked back on the weeks with von Goebel in 1898 as the most influential of his life. Nor were the botanists of his adopted country without their stimulus; one may specially

mention the very early contact with that ardent naturalist the late Hon. G. M. Thomson.

Fortunately situated he was able to spend many months each year exploring the wilds, especially of South Island, and in the course of these excursions, often with his great friend R. Brown, the bryologist, he gained that background of knowledge that was to serve him so well when he came to write his comprehensive works on the vegetation of New Zealand. He was 44 when the first paper on purely botanical subjects to appear from his pen was published—a description of the successional results following on the burning of some sub-alpine scrub at Arthur's Pass, the happiest of all his hunting grounds. This paper is linked with one of the last he wrote, 'The present vegetation of Arthur's Pass (New Zealand) as compared with that of thirty-four years ago' (1932). In this, by means of comparative photographs, a vivid picture of the changes is given. In those early days too he learned to endure, if not calmly yet steadfastly, any hardship for the sake of his beloved science.

The sowing of the innumerable seeds he collected and received in exchange brought to his attention many examples of heteroblastic development, and resulted in the important paper of 1899 on seedling forms in New Zealand phanerogams. From then on came an unbroken series of papers and books, of which may be mentioned: 'A sketch of the plant geography of the Waimakariri river basin' (1900), 'A short account of the plant covering of Chatham Island' (1902), 'A botanical excursion during midwinter to the Southern Islands of New Zealand' (1904), 'Report on a botanical survey of the Waipoua kauri forest' (1908—to be followed by equally notable reports on the Tongariro National Park, Stewart Island, and the dune areas of New Zealand), 'The ecological botany of the Subantarctic Islands of New Zealand' (1908), 'New Zealand Plants and their Story' (1910—to go into five editions), 'Observations concerning evolution derived from ecological studies in New Zealand' (1912), 'A consideration of the terms "species" and "variety" as used in botany' (1917—to be followed by many papers expanding and illustrating his taxonomical principles), 'An economic investigation of the montane tussock-grassland of New Zealand' (1919-1922), 'The vegetation of New Zealand' (1921; appearing in a second enlarged and greatly improved edition in 1928), 'Hybridism in the New Zealand flora' (1923—the forerunner of a number of contributions to the subject of wild hybridism), 'Monograph on the New Zealand beech forests' (1926-1928), 'On the New Zealand wild hybrids of *Nothofagus*' (1926, with E. Atkinson), 'The bearing of ecological studies on botanical taxonomic conceptions and

procedure' (1927, with H. H. Allan), 'An annotated list of groups of wild hybrids in the New Zealand flora' (1934, with H. H. Allan).

Among the numerous tributes to his work may be mentioned the honours: Ph.D. Munich (1903), F.L.S. (1910), F.R.S. (1912), Hector Medal (1912), Hutton Medal (1914), Darwin Medal (1928), Mueller Medal (1928), C.M.G. (1929), Veitch Memorial Medal (1932). Serving long on the council of the New Zealand Institute, he was President in 1918-1919, and an original Fellow. He was also a Corresponding Fellow of several botanical societies. Great pride as he took in all recognition that came his way he valued still more the personally expressed appreciation of his fellow workers in the same field—the word of a von Goebel, for example: 'it is quite true that you introduced madam botany to New Zealand and you did more than anyone else for the biological understanding of New Zealand's plant world'—or, on a simpler note, 'Every time I write you I have to thank you not only for your letters, which always are a joy to me, but for a lot of other good things'.

The present writer stood in too close comradeship and working contact with Cockayne to give an unbiassed estimate of his botanical status, but he may quote the words of Sir Ernest Rutherford, when presenting the Darwin Medal: 'The award of a Darwin Medal to Dr. Cockayne is fitting because of the distinction of his work in fields in which Charles Darwin himself laboured. That distinction has been gained by the use of the Darwinian method: a true naturalist, Dr. Cockayne has waited patiently upon facts before drawing conclusions. For over thirty years he has made it his task to deepen and widen our knowledge of New Zealand botany in the broadest sense. He has not only worked himself with outstanding ability and untiring energy, he has imparted his enthusiasm to a school of younger colleagues, eager to advance his labours on the lines he has laid down. The excellence of Dr. Cockayne's work, from the ecological point of view, is recognized by botanists in every country and has made him one of the foremost living students of plant-associations; the taxonomic studies rendered necessary by his ecological results have led to those remarkable discoveries of natural hybrids in New Zealand that have won for him a world-wide reputation and have made on modern thought an impression akin to that produced by the results of Mr. Darwin's studies of plants under domestication. Dr. Cockayne's researches have had, on sylvicultural and agricultural procedure, a practical bearing which has been appreciated by and has influenced the policy of New Zealand statesmen'.

Possessed of a clear and lively style Cockayne was able to exert an influence far beyond the confines of the professional

botanists and horticulturists. He was ever ready to reveal to the general public, by means of lectures, illustrated by slides from his own great series of photographs, the wonders of the plant-life of New Zealand. His gardening lore was at the service of any truly keen grower, and his little book on the cultivation of New Zealand plants has greatly helped towards the acceptance of his view that 'our gardens should surely possess a peculiar stamp of their own, and a national horticulture come into being with not only a rich exotic garden flora but one where New Zealand plants themselves would play no inconsiderable part'. On every possible occasion, whether on Royal Commissions, at public meetings or in scientific circles, he would throw all his powers into advocating the preservation of New Zealand's vegetation and flora. The crown of his work on this side is his establishment of the Otari Open Air Plant Museum, near Wellington, the progress of which he watched over with absorbed attention. Almost to the last he would undertake the long walk from his home to give advice or to plant specimens. His magnificent conception of what the museum should eventually be is given in his paper, 'A scheme for the development and arrangement' of the museum (1932).

His overflowing enthusiasm sometimes led him into errors, and his love of argument for argument's sake often deceived his listeners as to his real views, but he was always ready to withdraw an opinion on sound cause shown. Easily aroused to ire, he rapidly recovered from these 'mutations' as he called them, and when working in the field was always ready to consider with care views expressed by his co-workers even if they conflicted with his dearest hypotheses. Not a good conversationalist, dogmatic in certain moods, he was a great talker on a wide range of subjects, full of anecdotes and reminiscences. He dominated any company he was in, whether in a railway carriage, the inn corner or round the camp-fire. Always in his work a strenuous condemner of the faintest suspicion of the 'scientific lie', he allowed in general talk his imagination to run rampant, would enhance the slightest incident to a great tragedy or a greater comedy. He would grind at an encyclopedia to secure a telling point for a dinner-table utterance. Rabelaisian in some moods, he was as elfin as a Shelley in others—a side revealed only to his intimates. Often appearing arrogant, he was at heart the humblest of men in face of the mysterious ways of nature.

No account of the influences that went to make Cockayne what he was would be complete without the mention of his devoted and self-effacing wife. All who met her loved her, and recognized her affectionate care, her tolerant understanding of his idiosyncrasies, her steadying influence in times of stress,

her guardianship of a great man. Fittingly Cockayne and his wife, who soon followed him to rest, lie on the upland overlooking the valley of the Otari garden, and looking out towards the 'Cockayne Heights' beyond.

H. H. ALLAN.

OTTO VERNON DARBISHIRE (1870-1934) was born at Conway on 16 March 1870, and died at Bristol on 17 October 1934. He was elected a Fellow of our Society in 1920. He received his school education in Dresden and Florence, and spent some months at the University College of Bangor before going up to Oxford, where he was at Balliol under Jowett. He studied with Vines, and took his B.A. with Honours in Botany. He then went to Kiel, and not only took his Ph.D. but also obtained the *venia legendi*, an uncommon distinction for an Englishman. He acted as 'assistant' to Reinke for two years and then returned in 1898 as lecturer at Manchester under Professor F. E. Weiss. After eleven years in Manchester he went to Armstrong College, Newcastle-upon-Tyne, in 1909, and, in 1911, was appointed lecturer in charge of the department of botany at Bristol University. In 1919 he was elected to the newly created Melville Wills Chair of Botany and this post he held until his death. During his twenty years at Bristol the department increased greatly in numbers of students, and he was active in obtaining increased accommodation and facilities for students and staff. He was alive to the importance of the work of amateur naturalists and did much to further their interests. He was twice President of the Bristol Naturalists' Society. At the time of his death he was President of the South-West Naturalists' Union, a body for the formation of which he had been largely responsible. He had also been President of the British Mycological Society and Vice-President of the British Ecological Society. During the war he commanded the Bristol University Officers' Training Corps. Time and energy were freely given, not only to his department, though that always took first place, but to any individual or society seeking his aid.

Darbshire's scientific work started with his doctorate thesis at Kiel—'Die *Phyllophora*-Arten der Westlichen Ostsee, Deutschen Anteils'. Throughout his life he maintained his interest in the Rhodophyceae, and published several papers on that group, including a monograph of *Chondrus* written for the Liverpool Marine Biological Committee. He was never happier than when conducting a students' excursion on the shore at Swanage or Ilfracombe. But his chief interest was in the lichens, and his principal work was done on that group. This, too, started at Kiel with a monograph of the Roccellaceae, a work that is still

a standard and a model. In 1928 he issued a series of maps of the distribution of the family in the 'Pflanzenareale', and at the time of his death he was engaged on a revision of his monograph which had, unfortunately, got no further than preliminary note-making. He published many papers on the structure, ecology and taxonomy of the group. He was responsible for the treatment of the lichens collected by several important expeditions, including the National Antarctic Expedition, The British Antarctic (*Terra Nova*) Expedition, the Swedish Antarctic Expedition and the second Norwegian Antarctic Expedition. Of his other work mention may be made of a 'School Botany' and of the fine series of photographs of the Lancashire Sand Dunes contributed to the 'Vegetationsbilder'.

As a teacher Darbishire was equally successful in awakening the interest of the beginner and in inspiring the advanced student with his own enthusiasm for research. He was always full of curiosity about any living object and had an astonishing faculty for observing the unusual or interesting in the garden, the greenhouse and the field. Outside botany his interests embraced music and literature; he was a man of liberal sympathies and alert mind. As a young man he was an oarsman, and later—until after a serious accident in 1927—he played a good game of tennis. In social life he was a charming and entertaining host, who could surprise a dinner party with an impromptu conjuring entertainment. His loss is felt by a very wide circle of friends. He is survived by a widow and two young sons.

M. SKENE.

HUGO DE VRIES (1848-1935), the son of a former Prime Minister of Holland, was born at Harlem in 1848, so that at his death on 20 May of the present year he had attained the ripe age of 87 years, still retaining his mental vigour and his scientific interests. His early botanical studies were carried out in Holland, but he subsequently visited several German Universities, working for a time with Sachs in Würzburg. Not unnaturally, therefore, his first investigations were in the field of Plant Physiology, his doctor's thesis in 1870 dealing with the influence of temperature on plants, attention being specially directed to the osmotic pressure of the cells and the permeability of protoplasm. These studies led him to apply plasmolytic methods to the measurement of the osmotic pressure of cells, a method still employed in physiological researches. He was able to show in 1884 that osmotic pressure depends upon the number of molecules in solution, and he used his knowledge to determine the molecular weight of raffinose.

Coming under the influence of Darwin's publications

De Vries was particularly attracted by the theory of pangenesis put forward by Darwin in the second volume of 'Animals and Plants under Domestication' to explain some of the phenomena of heredity and variation. Darwin supposed that the various cells of a plant contained hosts of inconceivably minute particles or genes, the carriers of hereditary characters, particles which were constantly increasing in number and which passed from the vegetative to the reproductive cells. The importance of such a hypothesis impressed itself on De Vries, who modified it in accordance with the more recent knowledge of the cell and nucleus, and published in 1889 his 'Intercellular Pangenesis'. The views set out in this remarkable publication have guided much of his later work, and he refers to them with emphasis and further modification in his last important book on 'Gruppenweise Artbildung' (1913). One of the features distinguishing De Vries's theory from that of Darwin is that he assumes the pangenes to be active in the cytoplasm and inactive in the nucleus. Later he adopted the view that some might be in a labile state. But though intensely interested in theoretical considerations which might help to explain the phenomena of heredity and variation De Vries was essentially by nature and training an experimental scientist. For him 'The origin of species is an object of experimental investigation'. With this in view his researches led him to discover the segregation of parental characters in plants before the rediscovery of Mendel's work at the beginning of the century. His name, however, will be always associated with the 'Mutation Theory' (1901-1903), in which he puts forward the view that the origin of species is not due primarily to the slight continuous variations which Darwin held to be the more important, but to the discontinuous variations (mutations), while Darwin thought these so-called 'sports' to be too infrequent in their occurrence to be able to give rise to new species, De Vries had discovered in *Oenothera Lamarckiana* a plant in which mutations were arising at every generation. He also believed that other genera with numerous species, like *Draba*, *Viola* and *Helianthemum*, had at some previous time passed through a period of mutation. In his 'Gruppenweise Artbildung' (1913) he suggests that, in addition to the normal active and inactive pangenes, there are also unstable or labile pangenes which are the most important for the production of mutations, and that the period of mutation is dependent upon the increase of labile pangenes.

A comprehensive account of De Vries's genetical work has been published by Stomps under the title of '25 Jahre Mutationstheorie' (Jena, 1931). Of his contributions to Plant-physiology a critical appreciation by H. R. Oppenheimer

will be found in the 'Palestine Journal of Botany' (vol. i. no. 1, 1935). De Vries's collected works were published in six volumes in 1920, a seventh volume dealing with the various papers on *Oenothera* being added in 1927.

De Vries was elected a Foreign Member of the Royal Society in 1905 and was awarded the Darwin Medal in 1906. He received the Linnean Medal from the Linnean Society in 1929.

He held the Professorship of Botany in Amsterdam from 1878-1919, when he retired at the age of 70 to Lunteren to continue his experimental work. It must have grieved the visitors to the International Botanical Congress at Amsterdam, a town so long and closely associated with De Vries's work, that his kindly and venerable figure was not amongst them, but his memory was in their midst. F. E. WEISS.

GEORGE FRANCIS SCOTT ELLIOT.—Born in 1862 in Calcutta, where his father held an appointment, Scott Elliot graduated at the age of twenty in the University of Cambridge, taking the Mathematical Tripos in 1882. He then proceeded to the University of Edinburgh, where, after taking the degree of B.Sc., he assisted Professor A. Dickson at the Botanical Gardens, conducting an advanced class in practical botany.

The urge to travel, which was such a distinguishing feature of his character, took him to the Canaries and subsequently to South Africa, where he spent some time in botanical explorations, travelling with a waggon team into the Transvaal and into Natal. From here he proceeded on a six months' exploration of Madagascar, securing a large number of interesting plants, many of which were new to science. Mauritius too was visited on this occasion. He then turned his attention to northern Africa, and starting from Tripoli proceeded as far as the Second Cataract of the Nile. The knowledge of the flora thus obtained led to his appointment as botanist to the French and English Delimitation Commission of the Sierra Leone boundary (1891-2). An account of the plants collected on this occasion he published in the 'Journal of the Linnean Society' (vol. xxx. 1894). With the aid of a grant from the Royal Society he next explored British East Africa, spending four months in the neighbourhood of Mount Ruwenzori collecting a large number of plants. Never of robust physique, a breakdown in health caused him to return earlier than he had intended. An account of his experiences on this expedition will be found in his 'Naturalist in Mid-Africa', published in 1896.

He now settled down to a lectureship in Botany at the Royal Technical College, Glasgow, where he taught with great success for the next eight years; but his love for travel re-awakening, he paid a four months' visit to Chili and the

Argentine. In 1913 he purchased an estate in Kirkcudbrightshire, and retired there to develop his interest in farming, particularly in poultry rearing. Being a lieutenant in the Territorial Force, he joined the King's Own Scottish Borderers, and was active with a battalion in Egypt at the outbreak of the Great War, and received from the Khedive the Order of the Nile for notable work at Katib Gannit. On his return on leave the ship on which he was a passenger was torpedoed and sunk off the coast of Italy.

After the war for reasons of health he moved south, and took up his residence at Tunbridge Wells, rejoining the Linnean Society, of which he had formerly been a Fellow, having been originally elected in 1890. He developed a considerable interest in the flora of the district to which he had retired, and commenced a detailed study of various species of flowering plants, publishing very useful and readable accounts of the Earth Nut, the Blackberry, the Birch, the Blackthorn and the Hedge Woundwort in different journals. He was particularly interested in the pollination of flowers, and his 'Flora of Dumfriesshire' contains much original information concerning the insect visitors to many of the flowers.

The hardships of some of his expeditions and the strain of his active participation in the Great War had told upon his health, and in 1933 a stroke laid him low, and he never recovered his strength. He died in June of 1934 in a nursing home at Dumfries. A full biography by his friend A. A. Dallman, including a portrait as well as a list of his published books and papers, will be found in volume ix. of the 'North Western Naturalist'. I am greatly indebted to the author for permission to make use of some of the subject matter.

F. E. WEISS.

CHARLES HENRI MARIE FLAHAULT (1852-1935) was born at Bailleul on 3 October 1852, and died at Montpellier on 3 February 1935. He was elected a Foreign Member of our Society in 1915.

He was educated at the Collège d'Amiens, and had just ended his school days when the Franco-Prussian war broke out. Too young to be in the army he acted as a messenger, carrying comforts to his brothers and friends in camp near Arras. This experience of invasion and his subsequent service in the *chasseurs à pied* coloured his opinion and behaviour throughout life—he was an ardent patriot and, even as an old man, marched on excursions like a soldier.

The early death of his father left the family in somewhat straitened circumstances, and, rather than spoil an elder brother's education, he himself started his career as a working apprentice at the Jardin des Plantes under Decaisne.

soon perceived the quality of the young man who spent all his spare hours in the library, and took him into the laboratory, then under van Tieghem. A short time later he was enabled to enter the Sorbonne and study for his Licence ès Lettres, and there he became assistant to Duchartre. In 1881 he was called to Montpellier, and was given the title of Professor in 1883. At Montpellier he remained, with the exception of a short absence in Strasbourg just after the war, until he resigned the chair in 1927.

Flahault's first work was anatomical—the long paper which gained him his doctorate, entitled 'Recherches sur l'accroissement terminal de la racine chez les Phanérogames'. While at Paris he also worked on the algae under Bornet; and later he was responsible for the treatment of *Zostera* and related genera in Kirchner, Loew and Schroeter's 'Lebensgeschichte'. But he will always be associated with the revival of interest in plant geography and in the development of the study of plant ecology. It is probable that his interest in vegetation was first aroused during an expedition he made to Sweden along with Bonnier, and that his appointment to Montpellier finally determined the line he was to follow. With Bonnier he published the work on the effect of high altitudes and latitudes on the form and structure of plants. From Montpellier he explored the Mediterranean region of France. An enthusiastic and expert field botanist he led many of the 'herborisations' of various botanical societies, and for these prepared accounts of the flora, often preceded by introductions of phytogeographical interest. His introduction to Coste's 'Flore de France' is, in fact, his most important work on vegetation. He originated the large-scale vegetation map, and completed no less than eight sheets of France on a scale of 1 in 200,000; of these only one—that for the Pyrénées orientales—was published. A plan for a complete 'carte botanique, agricole et forestière de la France' did not receive the public support and assistance which alone could have made it practicable.

Though he had no great sympathy with the more modern developments of ecology Flahault must be looked on as one of the pioneers of this branch of study. It happened that his connection with work in this country was particularly close. Patrick Geddes sent his most brilliant student, Robert Smith, to work with Flahault at Montpellier, and brought Marcel Hardy from Montpellier to Dundee as his assistant. Both these young men applied Flahault's methods to Scottish vegetation. Hardy published a striking 'esquisse' of Scottish vegetation, and Smith and his brother mapped the vegetation of several Scottish counties. As a result there was formed in 1904 the 'Central Committee for the survey and study of British Vegetation', and from this the present

British Ecological Society took its origin. The remarkable vigour of the movement was evidenced by the publication, in 1911, of the 'Types of British Vegetation', a work dedicated to Warming and Flahault.

Flahault was a born teacher. As a young man he frequented the gallery of the Comédie Française as a student of elocution rather than as a devotee of the drama. At Montpellier he had to deal with an unusually large proportion of foreign students, many of them Russians, and he developed a remarkably clear and precise diction. When I went there, with a book knowledge of French, I found that I could understand him perfectly, while everyone else was still completely incomprehensible. To foreign students he was always ready with advice and often with practical help. Both he and his wife were the soul of hospitality, and would ask students to recover from the strain of examinations at their cottage at Hort de Dieu on Mont Aigoual.

Flahault's work on vegetation led him, through a consideration of the limits of the different types of forest in the south of France, to an interest in practical problems of forestry. In his later years the idea of re-forestation large tracts in the Midi filled his mind. Here his patriotism could make use of his scientific attainments. His gifts as a teacher were diverted to purposes of propaganda, and he travelled the country, laying out nurseries, persuading officials and advising foresters. It was said of him that he was the apostle of forestry in France, and one of his students added: 'L'expression s'appliquait bien à cet homme endurant, sobre, ardent, à la parole chaude, qui s'imposait comme un chef et qui savait entraîner ses auditeurs'.

M. SKENE.

JOHN FRASER, V.M.H. (1854-1935).—John Fraser, a figure well known in horticultural circles, died in Charing Cross Hospital on 24 January 1935.

Fraser was a native of Newdeer, a village situate about fifteen miles from Fraserburgh, Aberdeenshire, where he was born on 31 January 1854. He was educated at the Parish School, Monquhitter, and the Aberdeen Grammar School. He received his earlier horticultural training in Scottish gardens.

In 1880 Fraser came south and joined the staff of the Royal Horticultural Society at its Chiswick garden. Two years later he entered Kew, and for a time had charge of the Rock Garden and afterwards some of the glass-houses. In May 1885 he severed his official connection with Kew and became botanical assistant to Sir John Lubbock, afterwards Lord Avebury, with whom he was associated for many years. It is now well-known that the research carried out in connection with Lord Avebury's books on seedlings, pollen and other

botanical publications was largely the work of Fraser. He joined the staff of 'Gardening World' as assistant editor in 1887, being editor from 1897 to 1909. He was also a contributor to a number of horticultural works, including Thompson's 'Gardener's Assistant', Cassell's 'Popular Gardening', Cassell's 'Popular Science' and the 1917 edition of Johnson's 'Gardener's Dictionary'. In addition to this he was a regular contributor to the principal horticultural and botanical journals. He did much valuable work for the Royal Horticultural Society as External Examiner at Wisley (1908-34), and also acted in a similar capacity at Chelmsford in 1895, where he conducted courses in horticulture in the early nineties.

From his earliest years Fraser had been interested in the British Flora, and eventually became one of our best field botanists. He was a very keen collector and an acute observer. During the collecting season all his Sundays were spent in solitary botanical excursions, mostly in Surrey, but he was also very familiar with the Scottish Highlands, which he explored very thoroughly for willows. He specialized in the difficult genera *Rosa*, *Mentha* and *Salix*, upon which he eventually became an acknowledged authority. His published work on these genera indicates sound research and a great deal of patient investigation. All Fraser's work was indeed characterized by great care and thoroughness.

The writer of this notice, who had the privilege of his friendship for a quarter of a century, and shared his tastes, is indebted to him for innumerable kindnesses. He was of a modest, unassuming and kindly nature, and his encyclopaedic knowledge was always freely placed at the disposal of anyone who consulted him.

During over half a century's collecting he amassed an extensive and valuable British Herbarium, which includes a very fine set of *Salix* and a unique series of seedlings numbering several hundred sheets. This alone is a monument to his amazing industry. The Herbarium at his express wish was left to Kew.

His end was tragic. While crossing Kingsway on the afternoon of 17 January he was accidentally knocked over by a pedal cyclist, sustaining a fractured skull and other injuries. He lingered for a week in Charing Cross Hospital, and then succumbed to pneumonia, which supervened as the result of the shock. He was buried in Richmond Cemetery.

Fraser's services to Horticulture were deservedly recognized by the Royal Horticultural Society in 1922, when he was awarded the V.M.H., and seven years later he received the Veitch Memorial Medal and £50 for his work on *Mentha*, *Salix* and *Pelargonium*. He was elected a Fellow of the Linnean Society in 1889.

A. B. JACKSON.

GEORGE FRY (1843-1934).—By the death of George Fry in his 92nd year, on 29 June 1934, the Society has lost another of its long-lived Fellows. He was elected a Fellow on 2 November 1882, thus nearly completing his fifty-second year of Fellowship. He was born at Arundel, Sussex, on 17 January 1843, and traced his descent from Robert Frie, a yeoman at Steadham, Sussex, who died in 1616; but his immediate ancestors had lived at Lyminster, between Arundel and Littlehampton, where they were engaged in the timber trade. He continued that business with much success; and in the late 'sixties and early 'seventies of last century carried out experiments in making wood pulp, eventually collaborating with C. D. Ekman, a Swedish chemist and engineer, in introducing the Ekman-Fry process for making paper from wood pulp. His business interests, however, represented only one side of a very versatile mind. As a young man he was a keen water-colour painter and had travelled widely in Europe. A good linguist, with French as his favourite language, he acquired during his long life a valuable library composed largely of works of French literature and science. Greatly attached to music, he was a fine performer on the 'cello. With a natural inclination towards scientific investigation, he carried out experiments in the sowing of seeds and the fertilization of flowers, on the rise of sap and the growth of trees, and on the structure of woods. In 1900 he commenced a series of experiments on varnishes in relation to violin-making, and in 1904 published a book, 'Italian varnishes'.

In 1882 he took up farming as a recreation, building a house at Chobham, Surrey, on scientific principles of ventilation. He there introduced a system of sweet ensilage for the use of his cattle, and published a book entitled 'Sweet Ensilage' in 1884. In 1894 he removed to Berwick-on-Tweed, and carried out to greater perfection his ideas on house construction. His music-room there was specially constructed for acoustic purposes and its walls panelled with the choicest woods. Always a keen gardener, he had a fine rock-garden sloping down to the banks of the Tweed.

An old friend of T. H. Huxley, nevertheless Fry had an antipathy to the Darwinian theory of Natural Selection. He had a great admiration for the works of Fabre on insects, and would read them only in the original French.

In addition to our own Society, he belonged to the Chemical Society, the Royal Society of Arts, the Royal Agricultural Society of England, the Marine Biological Association of the United Kingdom and the British Science Guild.

For the information contained in this notice I am indebted to Mr. Edward Fry, a cousin of our late Fellow. S. SAVAGE.

SYDNEY TURNER KLEIN (1853-1934).—Sydney Turner Klein died at his home in Kent on 8 October 1934 after a long period of ill-health.

S. T. Klein was born on 4 November 1853 at Redhill, Surrey, and educated at Haileybury.

He entered the firm of William Klein & Sons, corn brokers, and was a partner until his retirement about 1916. The firm has since been dissolved.

In his youth Klein was a very keen yachtsman and an active huntsman and golfer, besides being a prominent freemason and an extensive traveller.

In 1886 he was largely responsible for the formation of the County of Middlesex Natural History and Science Society, and acted as Honorary Secretary and Treasurer, but the Society did not long survive.

He was elected a Fellow of the Linnean Society in 1887 and of the Entomological Society in the same year, and was also a Fellow of the Royal Astronomical Society.

During the war he became crippled with arthritis, and for the last fifteen years of his life was forced to move in a wheeled chair.

In 1912 he published the first of a series of books on science and philosophy, 'Science and the Infinite' (reprinted 1917 and 1924). This was followed in 1924 by 'The Way of Attainment' and in 1929 by 'The Garden of Enchantment'. He also published 'From the Watch Tower'.

It was no doubt due to his inability to follow his favourite pursuit of entomology actively that his mind turned to introspection and contemplation as a recreation, and resulted in the original views of life expressed in his books, which he hoped would bring comfort to his fellow men.

His affliction necessarily prevented his attendance at the meetings of scientific societies or taking active part in their work during the latter part of his life, but he was nevertheless keenly interested in reading the publications of the societies to which he belonged.

His portrait is published as a frontispiece to his work 'The Garden of Enchantment', a copy of which is in the library of the Society.

I am indebted to his son, Mr. S. Bernard Klein, for some of the details given above.

FRANCIS J. GRIFFIN.

HENRI LECOMTE (1856-1934).—The death of Professor Lecomte removes a well-known name from the list of Foreign Members of our Society. After a long and painful illness he passed away on 12 June 1934, and was buried at Vagney (Vosges) four days later.

It has been the duty of the present writer to work at the

Paris Museum for a short period nearly every year for the last ten years or so, and as a preliminary it was a regular and pleasant ceremony to be ushered into the Professor's office for a few minutes. It always seemed like stepping back into the middle of last century, for until recently the herbarium and administrative offices had undergone little change since they were first built.

Lecomte was born at Saint-Nabor (Vosges) on 8 January 1856, and obtained his preliminary education at the village school. In 1872 he entered the teachers' training school at Vosges, and qualified as a teacher in 1876. Not satisfied with this, however, he studied at Nancy in 1880, and in 1881 took his degree in Natural Science, and in 1883 a degree in physical science. At Nancy he was a pupil of G. Le Monnier, and met there Louis Mangin, whose colleague he became later at the Jardin des Plantes.

In 1884 he became more intimately connected with applied botany. In that year he was appointed professor at the Lycée Saint Louis, in Paris, and in order to take his doctor's degree became a pupil of van Tieghem at the Paris Museum. There he worked on the anatomy of plants, and collaborated with van Tieghem in a paper on the structure and affinities of *Leitneria*. For his doctor's degree he wrote a thesis entitled: 'Contribution à l'étude du Liber des Angiospermes'. This is still regarded * as a standard work.

In 1893 Lecomte was chosen to accompany as naturalist an expedition to construct a railway to the interior of Gabon, West Africa, and he returned from this with an important collection and with a keen interest in colonial development. At this period a vast French colonial empire was being built up, and Lecomte studied assiduously the available literature on tropical agriculture, and compiled several works for use in the tropics, mainly on cocoa, rubber, cotton and vanilla. This led to his appointment as editor of the 'Revue des Cultures Coloniales', and he continued his researches in van Tieghem's laboratory on rubber, fibres etc. In 1898, in connection with the importation of rubber, he visited Martinique, Trinidad and St. Lucia, whilst in 1903 he was entrusted by the Government of Senegal to investigate the cultivation of cotton and *Arachis* in Egypt.

In June 1906, when 50 years of age, Lecomte succeeded Bureau as professor at the Paris Museum in charge of the herbarium, and from this date he worked mainly on systematic botany, especially in relation to the French colonies.

* See obituary notice by A. Chevalier in Rev. Bot. Appl. et Agric. Trop. 1934, p. 1070, from which some of this information has been obtained.

He commenced the 'Flore Générale de l'Indo-Chine', not yet completed, and worked out many of the more difficult families, studying also their anatomy. In 1912-13 he accompanied Finet to the far east, and visited the main regions of Indo-China, returning with important collections. During the voyage he visited the gardens of Japan and Buitenzorg. On his return he began the 'Notulae Systematicae' for the publication of the novelties described at the Museum.

In 1916 Lecomte was elected a Foreign Member of our Society, and in 1917 became a member of the Academy of Science, Paris. Chevalier tells us that during his keepership the herbarium acquired many notable collections, including that of Drake del Castillo, Adanson's historic herbarium, Finet's library and the Fern herbarium of Prince Roland Bonaparte. Owing to lack of accommodation he missed the acquisition of Bonaparte's general herbarium, which went to Lyons University; but it must have given him very great pleasure towards the close of his career to see the erection of a magnificent new building to house the historic collections which had been so long under his care. J. HUTCHINSON.

JAMES LOMAX (1857-1934).—Born at Elton, near Bury, in Lancashire, the son of the manager of the Elton Collieries, James Lomax commenced work as a miner at an early age, as was then customary. He followed this occupation until 1888. Like many Lancashire working men at that time he took an interest in natural history, and became acquainted with Professor W. C. Williamson, of the Owens College, through attending some of his public lectures. He became interested in the latter's researches into the structure of Coal Measure plants, and began collecting the coal-balls, in which their remains were often very perfectly preserved, from the various localities in which they were found. These he ground into sections thin enough for microscopical investigation. Being of a mechanical turn of mind he gradually perfected his methods, and became a most useful purveyor of slides of fossil plants to investigators like Williamson, Scott, Kidston and Oliver, and also to many botanical institutions and museums both at home and abroad.

In 1911 Lomax developed methods of making thin sections of coal, the brittleness of which had made it difficult to prepare sections thin enough for microscopic observations. He correlated the amount of bituminous substances observed in the coal, both with its various properties and coke-producing qualities, and this led the Lancashire and Cheshire Coal-owners Association to take over the Lomax Palaeobotanical Laboratories for the Coal Research Association which was

established in 1920. James Lomax acted as director of the microscopical work until two years ago, when he retired. He had latterly been engaged in a correlation of the various coal seams by their spore contents. He was able by special methods to separate these from the coal, and a paper on this subject was embodied in a report to the Fuel Research Board.

Last October James Lomax had an acute attack of bronchitis, and died after a short illness. He will be remembered as a keen and persevering worker. He was elected an Associate of the Linnean Society in 1913, was a Fellow of the Geological Society and a member of the Institute of Mining Engineers. He served on several occasions on the Council of the Manchester Geological and Mining Society, and published several papers in their proceedings. His son Joseph, who has worked for thirty years under his father's direction, will carry on the work in which his father was a pioneer. F. E. WEISS.

Mrs. MARY JANE LONGSTAFF (née DONALD).—Mrs. Longstaff, who died at Bath on 19 January 1935 at the age of 79, was best known as an authority on Palaeozoic Gastropoda, but also possessed a good knowledge of recent non-marine mollusca, and was, indeed, an accomplished all-round naturalist.

She was the eldest of four children of Mr. Matthewman Hodgson Donald, of Carlisle, her mother being a daughter of the Hon. J. H. Roper-Curzon, fourth son of the 14th Baron Teynham. On leaving school she studied for a time at the Carlisle School of Art, but entered no profession. From an early age she took a keen interest in natural history, and explored the countryside for shells and botanical specimens. This work culminated in her first paper, 'Notes on the Land and Freshwater Shells of Cumberland', which was read at the annual meeting of the Cumberland and Westmorland Association for the Advancement of Literature and Science at Carlisle in 1881.

Encouraged by the late Mr. J. G. Goodchild, of H.M. Geological Survey, for many years an active member of the Cumberland Association, she now turned her attention to the fossil shells of the district, and in 1885 presented her first paper on this subject, entitled 'Notes on some Carboniferous Gasteropoda from Penton and elsewhere', which was published in that association's 'Transactions'. This was followed by a long series of important systematic papers on Palaeozoic Gastropoda, most of which appeared in the 'Quarterly Journal of the Geological Society', the last so recently as 1933. Many of these will long remain standard works of reference, and all bear evidence of most thorough and painstaking research. Working purely as an amateur, she pursued her studies with remarkable perseverance, visiting

in turn the various museums in this country and abroad, where material for study as well as relevant literature were to be found. The illustrations which accompany her papers were, moreover, mostly executed by herself, and show that she possessed artistic ability of no mean order.

She travelled very widely apart from this work, particularly after her marriage in 1905 to Dr. George Blundell Longstaff, a distinguished entomologist, who predeceased her in 1921. The regions visited by her include northern and South Africa, Australia, South America and the West Indies. In the field she interested herself more in recent mollusca than in fossils, and formed an extensive collection of shells, upon which she contributed papers from time to time. The most important of these is one describing a collection of non-marine mollusca from the southern Sudan, published in 1914 in the 'Journal of the Linnean Society (Zoology)'. Other papers appeared as appendices to entomological works by her husband, notably his 'Butterfly Hunting in Many Lands' (1912). One or two short papers dealing with the non-marine shells of Mortehoe (Devon) were published in the 'Journal of Conchology' from 1909 onwards. Some interesting experiments in breeding the large South African land-snail *Cochlitoma*, extending over several years, were described by her in 1921 in the 'Proceedings of the Zoological Society'. Mrs. Longstaff's large collection of recent mollusca, including the specimens referred to in these papers, has been presented by her nephew, Mr. M. H. Donald, to the British Museum (Natural History).

Mrs. Longstaff was elected a Fellow of the Linnean Society in 1908 and of the Geological Society in 1919. She also belonged to the Conchological Society, the Malacological Society, the Palaeontographical Society and the Geologists' Association. The value of her palaeontological work was recognized by the Geological Society so early as 1898, when she received an award from the Murchison Fund.

L. R. Cox.

KENNETH KENT MACKENZIE (1877-1934) was born in Brooklyn, New York, U.S.A., on 13 October 1877, but as a boy was taken by his parents to Muscatine, Iowa, where he was raised. He was educated at the Kansas City Law School, receiving the LL.B. degree in 1889. In 1906 he received the same degree from Columbia University in New York, and in this same year commenced the practice of the law in New York City. He was a successful attorney, but always maintained an active interest in botany, building up a private herbarium, estimated to contain 40,000 specimens, which was presented to The New York Botanical Garden a few years before his death. He also assembled a magnificent botanical library, which on his death was bequeathed to the Horticultural

Society of New York. He was a member of numerous scientific societies, and was elected a Fellow of the Linnean Society on 24 May 1927. From 1924 to his death he served as a member of the Board of Managers of The New York Botanical Garden. He was the author of many short papers on the flora of North America, but was best known in botanical circles as a specialist on North American *Carex*, his elaborate treatment of this critical genus now appearing in the 'North American Flora'. Mr. Mackenzie had prepared by the best available artist a magnificent series of between 500 and 600 illustrations of North American *Carex* and representatives of other genera of the Cyperaceae, which on his death were bequeathed by him to The New York Botanical Garden, together with a special fund to be expended in completing and publishing the series. He died at his home, Maplewood, New Jersey, on 22 October 1934.

E. D. MERRILL.

The late Dr. S. K. MUKERJI was born at Nowgang, Central India, in March 1896, and graduated from Muir College, Allahabad, in 1916. Subsequently he became Lecturer in Botany at Lucknow University, and it was during his tenure of this post that he came to England in 1925 to study at University College, London, for his Doctorate. This he obtained for a thesis dealing with ecological investigations on *Mercurialis perennis*.

It was impossible to be associated with S. K. Mukerji without realizing his energetic and enthusiastic temperament. Early in his career he was attracted to the ecological side of the subject, and a number of expeditions to Kashmir had not only enabled him to acquire a good knowledge of the flora of that region but had stimulated his interest in the many biological and edaphic problems that he encountered first hand. It was thus with a mind avid for instruction in ecological methods that Mukerji came to London and devoted himself wholeheartedly to his work. It was this very enthusiasm coupled with wide interests that was the cause of much of his work never reaching the stage of publication.

It was due to his knowledge of the modern Kashmir flora that, though primarily attracted to the ecology of this area, he was, at the time of his death, engaged on investigating the collection of fossil plants made by the Yule Expedition to Kashmir under Dr. de Terra.

Dr. Mukerji was elected a Fellow of the Society in 1926, and communicated a preliminary account of his work on *Mercurialis perennis*. He was the discoverer of a variety of this species, which was described in the 'Journal of Botany', February 1927.

By Dr. Mukerji's premature death Indian Botany has lost

an ecologist of considerable promise and also a colleague whose personality gained for him the esteem of those with whom he came in contact. E. J. SALISBURY.

ROBERT PAULSON was born in 1857 at Hendon, and a family removal to Ore, near Hastings, when he was about seven years of age, brought him into country surroundings and initiated that ardent love of nature which throughout life was a chief characteristic: the influence of a botanical friend early directed his particular attention to the study of plants. He was a type of field-botanist which nowadays is becoming scarce; but he was not this alone—collecting on country rambles was always accompanied by subsequent dissection and intimate study of the plants obtained.

A schoolmaster by profession, he had sufficient leisure to follow his bent in botanical expeditions both in this country and in Switzerland.

In the early days of the Toynbee Hall movement he undertook a voluntary class for botany students, of which the present writer still retains pleasant memory.

In 1901 he became a member of the Quekett Microscopical Club, and in 1907 was elected a Fellow of the Royal Microscopical Society, on whose Council he served from 1915 to 1917 and again from 1922 to 1924, being elected a Vice-President of the Society in 1918, and acting as Librarian from 1925 to 1926.

On 1 May 1913 he was elected a Fellow of the Linnean Society. He joined the Essex Field Club in 1899, served on its Council, and was its President from 1920 to 1923. He was also a member of the British Mycological Society since 1918.

In his later life Paulson made a special study of the Lichens, and his microscopic investigations of the lichen thallus, in collaboration with Somerville Hastings, served to demonstrate the normal production of daughter-cells (reduced zoogonidia) within the gonidia by division of the protoplast. He also took a special interest in the mycorrhizal association of the Agarics with certain forest trees.

For many years Paulson was a regular attendant at the Kew Herbarium and at the Department of Botany, British Museum, where as a voluntary worker he undertook the identification of lichens submitted by various foreign expeditions, including those to Mount Everest and to Spitzbergen.

During the last few years his powers showed signs of failure, and on 1 March of the present year he passed away at the age of 78.

In disposition Paulson was a most kindly, courteous man, of gentle manners, always ready to afford assistance in matters of education, friendly to all. PERCY THOMPSON.

PHILIP GRAFTON MOLE RHODES (1885-1934).—The Rev. Dr. Rhodes passed away at Evesham, Worcestershire, on 16 December 1934 at the early age of 49. He belonged to a Birmingham family, and was educated at King Edward's School of that city. He went to Pembroke College, Cambridge, later, where he won many prizes and took his degree with First Class Honours in Theology and Classics. At the end of his course he was ordained a curate of the Established Church at Kidderminster, where he remained for four years. Afterwards he became a Catholic, and was sent to Fribourg University, Switzerland, for the studies of the Catholic priesthood. In due course he took his doctorate of divinity. Later he was appointed Professor of Dogmatic Theology at Oscott College, Birmingham, where he proved very successful and was much liked. Leaving Birmingham after several years, he was appointed Parish Priest of the Catholic St. Mary's Church, Evesham, which appointment he held at his death.

He was a great lover of nature and natural history from his youth, and was an enthusiast to the end. In 1925 he was elected a Fellow of the Linnean Society.

He was a member of the British Bryological Society for many years, and contributed much to its success. He had a wide knowledge of mosses, hepatics and lichens, together with phanerogams.

During the latter part of his life he paid much attention to fungi of all kinds, chiefly Pyrenomycetes, which he exchanged with foreigners on a large scale. His collections of fungi went to Kew. He wrote some notes on the fungi of Worcestershire which appeared at different times in the 'Transactions of the Worcestershire Natural History Society'. In 1909 he compiled a list of mosses, hepatics and lichens of the Channel Islands which appeared in the 'Transactions of the Guernsey Society of Natural Science', and also contributed notes on the same groups to 'A Short Flora of Cambridge', edited by A. H. Evans, M.A.

His large and valuable herbarium of mosses, mostly British and European, comprising over 10,000 specimens was given a few years ago to the British Bryological Society, who presented it, with the donor's consent, to the British Museum (Natural History) on certain conditions. His hepatic and lichen herbaria went to the Birmingham Natural History Museum. He left his estate to the Fribourg University for the endowment of a scholarship.

The Rev. Dr. Rhodes was a gentleman in the true sense of the word, and, as one of his students remarked, 'a saintly man for whom those who come in contact with him had a real affection'. Many of us will miss him greatly and feel that we have lost a man of striking personality and of unfailing courtesy.

D. A. JONES.

ROBERT ALEXANDER ROBERTSON (1873-1935).—With the death of Professor Robertson in January of this year terminated a life devoted to the advancement of botany in Scotland.

Born at Rattary, Perthshire, in 1873, R. A. Robertson attended the village school. Thence he proceeded to Edinburgh University, where he graduated in Arts and in Science. Whilst a student physiology under Rutherford and botany under Dickson and Bayley Balfour were the subjects which, he stated, claimed his especial attention. In 1889 he came to St. Andrews as assistant to Professor W. C. McIntosh, but was called upon to instruct classes in botany and in physiology in addition. In 1891 he was appointed Lecturer in Botany, his status being raised to that of Reader in 1915. A chair of botany in the university was founded in 1929, and Professor Robertson became its first occupant. He retired in September 1934, after forty-four years of strenuous and splendid service for the university. The transition from an assistant without a room to professor with a large and well planned department was pioneer work indeed.

Robertson was a great teacher both in the class-room and in the research field. Labouring incessantly to keep himself proficient, he had the gift of imparting knowledge, developing initiative and creating enthusiasm.

The published record left by himself and his school covers a wide field. Photomicrography applied to opaque objects was pioneer work in 1898. It paved the way for an atlas dealing with the micro-identification of woods. The atlas was never published, but several of the plates were exhibited at the Royal Society, Burlington House. Anatomical studies in *Osmunda* and *Isoëtes*, in abnormal conjugation in *Spirogyra*, and in variations in *Lycopodium clavatum*, with their bearing on phylogeny, together with the application of anatomy as an aid to taxonomy of the genus *Potentilla* illustrate other lines of activity.

The advocacy of 'functional inertia' by examples from the vegetable kingdom stands out as yet another field of investigation during his early days at St. Andrews. Later his attention turned to 'sense organs' in plants, with first records of 'ocelli' in stems. Studies in growth and in transpiration in the succeeding years lead up to the publication of 'Plant Growth Rhythms' in 1913.

At the outbreak of the world war R. A. Robertson was Captain of the St. Andrews University O.T.C. He was an enthusiast for military training. Thanks to his efficiency St. Andrews was able to take a worthy share when the crisis came.

Following the war there issued from the St. Andrews botany school an interesting series of contributions on the maritime

flora of Fife. The flow of publications continued under the names of the individual investigators, Robertson scorning to countenance joint authorship.

A man of great understanding, with the gift of humour, a man of high principles and above subterfuge, he was a great and faithful soul. To his son and to his daughter our sympathy goes out for the sudden loss within four months of his retirement.

R. J. D. GRAHAM.

WILLIAM ROBINSON.—For some years before his death, which occurred on 12 May last, Mr. William Robinson had been senior Fellow of the Society. He was elected in 1866, and one of his proposers was Charles Darwin. Robinson, who owed nothing to birth or early education, had a remarkable career. Coming to London from Ireland in 1861 as an under-gardener at the Royal Botanic Society's Gardens at Regent's Park, at a wage of 9s. a week, he was soon appointed foreman of the herbaceous department, and remained in the Society's service for six years. During that time his natural love of plants, allied to a fervid imagination, gradually rebelled against the limitations of the then existing order of things horticultural, in which formality had so large a share, and he conceived a crusade against what he designated the shams of gardening. He was so obsessed with the idea that on leaving Regent's Park in 1867 he initiated his campaign for more natural gardening, for which he had been preparing by the publication of articles in the horticultural journals of the time. Fortunately for him Robinson was appointed horticultural correspondent of 'The Times' at the Paris Exhibition of 1867, and he was encouraged to contribute articles to the paper on any matter of horticultural interest that might come under his notice in France. This was the starting-point of Robinson's career, and his first important book, 'The Parks and Gardens of Paris', shows the excellent use that he made of his opportunities. A journey to the French Alps opened Robinson's eyes to the nature and extent of the alpine flora, and as a result of a visit that he paid to the United States he realized the extent to which British gardens could be enriched by the trees, shrubs and plants of the North American continent. On his return to England, Robinson, who had an innate flair for paper and ink, launched the weekly journal 'The Garden', following it up at intervals with 'Gardening Illustrated', 'Farm and Home', and 'The Cottage Garden'. All the time he was engaged on the making of books, and the first edition of 'The English Flower Garden' was published in 1883. The book has recently passed into its sixteenth edition, and has had a more wholesome influence on the trend of British gardening than any other. His next serious

work was entitled 'Garden Design and Architect's Gardens', a book in which he gave free expression to his pronounced views on the part played by architects in the design of gardens. An account of Gravetye Manor, the old Sussex ironmaster's house that he bought in the nineties, followed, and then came a small book on *Clematis* and an elaborately illustrated volume, 'Home Landscapes'. Sandwiched between these original works were minor publications, such as 'A Catalogue of Hardy Plants', 'Hardy Flowers', 'Les Semaines Françaises', as well as, in 1871, a revision of H. Loudon's 'The Horticulturist' and new editions (1869 and 1880) of Loudon's 'Amateur Gardener's Calendar'. Robinson also financed the publication of Shaw's 'London Market Gardens' (1869), Miller's 'Dictionary of Plant Names' (1885) and Baine's 'Greenhouse and Stove Plants' (1885). His journals, his books and shrewd investment of his income brought Robinson a substantial return, and beginning life as a penniless lad he left a fortune of nearly £100,000.

A. GROVE.

Dr. ROBERT FRANCIS SCHARFF, who was elected a Fellow of the Society in 1901, was born at Leeds in 1858 and died at Worthing on 13 September 1934. He was educated at University College, London, and afterwards in the Universities of Edinburgh (where he graduated as B.Sc.) and Heidelberg (where he graduated as Ph.D.). He also undertook zoological researches in the marine laboratories of Naples and St. Andrews. He became an assistant in the National Museum, Dublin, in 1887, and was Keeper of the Natural History Collections in the Museum from 1890 until his retirement in 1921. Dr. Scharff had a very wide knowledge of Zoology, and in 1895 he was awarded the Emperor Nicholas II prize of the International Zoological Congress for his work on the origin and distribution of the European Fauna, which was eventually published in London in 1899. In 1906 and 1908 he gave the Swiney Lectures on Geology under the auspices of the Trustees of the British Museum, and these formed the subject of his two volumes on 'European Animals, their Geological History and Geographical Distribution' (1907), and 'Distribution and Origin of Life in America' (1911). Dr. Scharff also made a special study of the fauna of Ireland and the Irish breeds of domestic animals, and from 1893 onwards he was Chairman of the Fauna and Flora Committee of the Royal Irish Academy. He took part in the exploration of several caves in Ireland, and made valuable contributions to our knowledge of the Pleistocene fauna of the country. He also did useful service as Secretary of the Royal Zoological Society of Ireland from 1903 to 1910. Dr. Scharff was ever ready to place his deep learning in zoology at the disposal of those who sought his

help, and his genial and kindly personality won for him a wide circle of friends. A portrait of him appears in the 'Irish Naturalist's Journal', vol. v. pl. 13, November 1934.

ARTHUR SMITH WOODWARD.

HENRY HARWOOD SMITH.—By the death of Mr. Henry Harwood Smith, which occurred in his 68th year at Haywards Heath on 13 January 1935, the orchid world has lost a prominent personality. At an early age Mr. Smith commenced his horticultural career with Messrs. W. Balchin & Sons, Hassocks, and subsequently entered the extensive nursery of Messrs. Sanders, St. Albans, where he obtained considerable experience in the handling of imported orchids. Further experience was gained in the nursery of Messrs. J. Cowan & Co., Gaston. In 1896 he was engaged by Mr. Charlesworth, and in course of time occupied important positions in his nursery at Bradford, becoming manager in 1901. In the early part of 1908 he was actively engaged in the planning of an entirely new nursery for the firm at Haywards Heath, where his energy was subsequently employed in building up a business of world-wide extent. Soon after the death of Mr. Charlesworth in 1920 Mr. Smith invited the principal members of the staff to join him in the formation of a private company for the continuance of the business, and from that date onwards he held the position of managing director. When the new method of raising orchids on agar, in flasks, was being tried on the Continent Mr. Smith made several first-hand enquiries regarding the process, and soon satisfied himself that it would prove a commercial success. Mainly on account of Mr. Charlesworth's keenness and ability, and the scientific assistance rendered by Mr. J. Ramsbottom, a method was worked out whereby the majority of orchids are now raised from seed in almost unlimited quantities and under clean conditions. Mr. Smith was elected a Fellow of the Linnean Society in 1923, and in the same year he became a member of the Royal Horticultural Society's Orchid Committee.

GURNEY WILSON.

RUPERT VALLENTIN was born on 15 November 1859 at Walthamstow, near London. He was a younger son of Sir James Vallentin, Sheriff of London and owner of the Rectory Manor at Walthamstow. He was educated at private schools. His father died while he was still young, leaving him to the care of guardians. For some time he was employed at an office in London, and then went to Australia, where he held for a short period the position of clerk to a Court in Northern Queensland. When he returned to England and came of age, having inherited sufficient

private means to satisfy his moderate requirements, he devoted himself to the study of natural history. He took private lessons in general zoology and also studied for a time at the University of Munich. It was probably to the fact that he made the voyages to and from Australia in a sailing ship *viâ* the Horn that he owed his life-long love of the sea and his interest in marine zoology.

I first made Vallentin's acquaintance about the year 1885 when I was in charge of the Scottish Marine Station at Granton, near Edinburgh. Sir John Murray, who organized the station at Granton with the co-operation of friends in Glasgow, afterwards founded a more permanent Marine Biological Laboratory at Millport, on the island of Cumbrae in the Clyde, and Vallentin spent several summer weeks with me at Millport in researches on the structure and function of the luminous organs of the Crustacean *Meganyctiphanes norvegica*. Our results were published in a joint paper in the Quart. Journ. Microsc. Sci. (xxviii, 1888).

Vallentin left Scotland in 1887, and for the rest of his life resided in Cornwall or Devon. When I went to Cornwall in 1897, to take charge of technical instruction concerning Fisheries, he was residing at Falmouth, where he had a small private laboratory on one of the wharves in the docks, and had been for some years carrying on, with the aid of a dinghy, his studies of the fauna of the estuary, especially of the floating life or plankton. The results of his researches were published in the Reports of the Cornwall Polytechnic Society, the Journal of the Cornwall Royal Institution, and the Ann. & Mag. Nat. Hist. At the time of my arrival he had been giving lectures and making enquiries concerning the fishing industry for the Technical Instruction Committee of the County Council. With characteristic generosity he handed over to me all his notes, his records of sea temperatures and collections. The work had been carried on in a thorough and systematic manner, and was of great assistance to me in taking up my duties as his successor.

In 1898-9 he visited the Falkland Islands, in order to compare the marine fauna and conditions of littoral life in about the same latitude in the south as that of Cornwall in the north. He returned to the Islands on a second visit in 1901-2. On the first of these visits he met Mrs. Nichol, the lady he afterwards married, and collections of marine algae, ferns and phanerogams were received from both of them at the British Museum (Natural History) in February and March 1899. He brought home collections of Medusae, Crustacea and Diptera, of which descriptions were published by Mr. E. T. Browne, the Rev. T. R. R. Stebbing and Mr. E. E. Austen, but in 1902 some of his collections were lost in a wreck.

In 1901 Vallentin left Falmouth for Newquay, where he lived for three years. His marriage to Mrs. Nichol took place in March 1904, and they lived at St. Ives till 1909. Mrs. Vallentin was the daughter of Mr. W. Wickham Bertrand, who settled in the Falkland Islands about the year 1871. Her sympathy and co-operation were of great value to her husband, and like him she had a strong interest in nature and natural history, especially in plant life. She had studied botany at Kew, and on her return to the Falkland Islands she gave much time and attention to making careful coloured drawings of the local plants. These beautiful illustrations, with descriptions by Mrs. E. M. Cotton, were published by Vallentin in 1921, after the failure of his wife's health ('Flowering Plants and Ferns of the Falkland Islands', L. Reeve and Co.). Plants collected in the Islands by Mrs. Vallentin are described in the Journ. Linn. Soc. 1911 and 1915. In 1909 the Vallentins moved from St. Ives to Mawnan Smith, near the Helford River, south of Falmouth, and in September of that year they left for the Falkland Islands, and did not return till 1911. In 1913 their son and only child was born. In 1916 Mrs. Vallentin's health broke down permanently, and she died at Plympton in 1924.

A very interesting description by Vallentin of his experiences and observations in the Falklands is included in a book on the Islands by Miss V. F. Boyson published in 1924 (Clarendon Press). He there describes not only the marine animals and algae which he made his special study, but gives a charming account of the scenery, the land vegetation and the penguins, geese and other birds. A specimen of the Elephant Seal, *Macrorhinus proboscideus*, was presented by Vallentin to the British Museum (Natural History), where it is mounted in the Lower Mammal Gallery.

In 1925 Vallentin went to live with his son at Exeter, and interested himself in the freshwater fauna of the Exeter Ship Canal. Here, on 21 July 1928, he obtained specimens of the freshwater Medusa, *Craspedacusta sowerbii*, the first time they had been discovered in a free state under natural conditions in England. The specimens were identified by Mr. E. T. Browne, F.L.S. Individuals of this species, first discovered in 1880 in the *Victoria regia* tank in Regent's Park, London, were first found in a free state in China (1907), first in Europe, in Germany (1911), first in America, at Frankfort, U.S.A., 1916-17. Vallentin carried on considerable correspondence concerning his discovery with zoologists who had made researches on this Medusa, especially with Dr. Emil Dejdar of Prague, who published a monographic memoir on the species in 1934.

Vallentin became a Fellow of the Linnean Society in 1889. He died in November 1934, after suffering from a painful

illness for about two years. His son states that he bore his illness with extraordinary patience and equanimity. He was distinguished throughout his life by his intense love of nature and the open air life. In his early days he avoided society and was somewhat solitary in his habits, but this was due chiefly to shyness and to a sensitive temperament which was easily disturbed by any departure from his regular and peaceful routine. He had, however, great force of character. He possessed a marked faculty for making and keeping friendships with other naturalists, and his correspondence was always interesting. He was in the best sense an amateur, and, considering the disadvantages of his early life and training, he deserves the greatest credit for the real services which he rendered to zoology as collector and ecologist. Those who knew him will remember him both for what he was and for what he did.

For much help in collecting the details of Vallentin's life and work I am indebted to many of his friends and fellow-naturalists, namely, Mr. E. T. Browne; Mr. A. Gepp, formerly of the Botany Department of the British Museum; Mr. A. D. Cotton, of the Herbarium, Kew; Dr. W. T. Calman, Keeper of Zoology, British Museum; and especially to his son, Mr. Thomas Vallentin, now a student of medicine at Bristol University.

J. T. CUNNINGHAM.

GEORGE CHAPMAN WALTON (1845-1934).—The passing of George Chapman Walton took place at Folkestone, Kent, on 6 November 1934, in the ninetieth year of his age. He had been a Fellow of the Linnean Society since 1 December 1881, and thus stood high in order of seniority. His death was singularly peaceful and serene, and he retained his faculties almost to the last.

Mr. Walton was born at Scaldwell, Northamptonshire, on 3 September 1845. He was the youngest of the seven sons of John Walker Walton, of Bedford, and he received his education in the Modern School of that town. He qualified as a Pharmaceutical Chemist, and lived in turn at Great Yarmouth, Bedford, Dartford, and at Farnham in Surrey. In 1873 he removed to Sandgate, and there carried on his business for a considerable time; here he was, for two years, Chairman of the Local Authority. In 1881 he obtained the Diploma in Dentistry of Dublin University, ultimately practising as a dental surgeon for many years in Folkestone.

About the year 1880 Mr. Walton came into connection with the Folkestone Natural History Society, which had been founded some twelve years previously. His thorough and practical acquaintance with the science of botany led him to become increasingly active and useful in the Society, which at

that time had charge of the Folkestone Borough Museum, then in the old High Street. Nearly every session, for fifty years subsequently, Mr. Walton lectured to the Natural History Society, usually—though not invariably—upon some botanical subject. In 1905 he became its President, holding that office until the time of his death, a period of nearly thirty years. His influence upon the Society was very great. He was enthusiastic for such work, and gave it unwavering support. It was mainly due to him that the organization has been carried on continuously, with only the inevitable interruption of war time.

Mr. Walton had early acquired a wide knowledge of *materia medica*, and his great love of plant life came to him as a result. He excelled as a field botanist, and in teaching and lecturing was clear and concise, with a simplicity due to understanding. His help was widely sought and liberally given. In the year 1893 the Natural History Society printed his 'List of the Flowering Plants found in the neighbourhood of Folkestone'. This list still stands, in the main, as authoritative. Good use was made of his thorough knowledge of the Folkestone district during the preparation of Hanbury & Marshall's 'Flora of Kent', and his name frequently appears in that work.

To the Folkestone Borough Museum Mr. Walton gave a very great deal of help. He served continuously upon the Library and Museum Committee of the Town Council from its constitution in 1888 until shortly before his death, a period of forty-five years. He was also, during this long time, Botanical Curator.

For over thirty years, too, Mr. Walton was a member of the Folkestone Borough Education Committee, doing much useful work.

Religious activities filled a great part of his long life. He was a lay-preacher in the Wesleyan Methodist Church for seventy-three years. He occupied in turn every lay office in his Church; he was also local treasurer for the British and Foreign Bible Society for forty years.

It is not unfitting to record his simple, deep and wondering love of Nature, and his humble and reverent attitude towards her profound secrets. Science was almost a religion to him, and religion was his life.

He married, in 1874, Mary Elizabeth, daughter of John Nash, of Farnham, Surrey. His daughter and two of his four sons survive him.

J. W. WALTON.

ELLEN ANN WILLMOTT.—Miss Willmott, who died on 27 September 1934, will long be remembered as a great gardener and enthusiastic botanist. The daughter of Frederick

Willmott, of Warley Place, Great Warley, Essex, Miss Willmott early developed a love of gardening, a taste which she shared with her sister, Mrs. R. V. Berkeley of Spetchley, and which was hereditary in her mother's family. At an early age she became the owner of Warley Place, the beautiful garden of which was well known on account of its associations with John Evelyn, a horticulturist as well as a diarist, who wrote much of his 'Silva' when it was his home. Many of the trees were of a great age, and the *Crocus vernus* which flourished in the meadows (and does to this day) is said to have been there since Evelyn's time. Though she maintained the general lay-out of the garden, Miss Willmott set to work to develop it, and acquired many rare and interesting plants. She specialized in herbaceous and rock-garden plants, daffodils and certain shrubs, such as Roses, and the garden became celebrated as possessing one of the most complete and best-named collections in the country. She also owned for a time a garden at Aix les Bains and another at La Mortola on the Riviera, where she cultivated plants suited to these localities; but, with restricted resources, these had to be relinquished.

Her love of plants was not limited to living collections; she took a keen interest in botany and the classification of plants, and had a good knowledge of the British and European floras. She built up a large herbarium of her own, most of which, however, was acquired through the purchase of various collections; her many interests no doubt prevented her to a large extent from undertaking the onerous task of drying and mounting. In 1920-21 she presented her 'Herbarium Warleyense', consisting of some 15,000 sheets, to Kew.

Miss Willmott also accumulated a very fine collection of botanical and horticultural books, including many of the old herbals, and a large series of periodicals, both British and foreign. Although she had critical knowledge she wrote and published but little, but there is one botanical monograph by which her memory will always be perpetuated, namely, the beautiful work entitled 'The Genus *Rosa*', published in two sumptuous volumes (1910 to 1914). The coloured plates were drawn by Alfred Parsons, R.A., and the botanical text was contributed by J. G. Baker. Miss Willmott bore the entire expense and contributed the general part on such subjects as history and horticulture. She also assisted in the financial support of several of E. H. Wilson's early plant-collecting expeditions to Western China and Tibet.

Amongst her other hobbies Miss Willmott was interested in music, pictures and in the practice of ornamental turning in wood and ivory, an art in which she herself attained great proficiency. As well as possessing a valuable collection of old musical instruments she was an accomplished violinist, and was an enthusiastic supporter of the Bach choir.

Miss Willmott was for many years a most familiar figure at the R.H.S. meetings and was a member of several of its committees. As a reward for her services to horticulture she was presented with the Victoria Medal of Honour in 1897, being one of the original holders of this distinction. Later she was appointed by Sir Thomas Hanbury one of the three trustees of the R.H.S. Gardens at Wisley. She was in continuous correspondence with Kew over a long period. Her interest in systematic botany drew her to the Linnean Society, and she was one of the first group of women to be admitted to the Fellowship of the Society (1904), and became a Life Fellow. The Grande Medaille Geoffrey St. Hilaire was conferred upon her in 1912 by the Société d'Acclimatation de France.

Though in later years her health failed somewhat her interest in plants remained to the end, and she normally worked in her garden with her own hands from dawn to dusk, even during the longer days. With her many interests Miss Willmott naturally had a very large circle of friends. She will be remembered for her strong personality, her sympathetic interest in many things, her contagious enthusiasm for plants and by the treasures from her garden, which were always at the disposal of her friends.

A. D. COTTON.

BENEFACTIONS

LIST *in accordance with Bye-Laws, Chap. XVII. Sect. 1, of all Donations of the amount or value of Twenty pounds and upwards, received during the past Twenty years.*

1915

The Trustees of the Percy Sladen Memorial Fund: Second Donation towards the sixth volume, £80.

Miss Foot: Cost of second paper on *Euschistus*, £32 10s.

Royal Society: Donations towards the cost of a paper by Mrs. Arber, D.Sc., £40.

The same: towards paper on Uta River plants by Mr. H. N. Ridley, C.M.G., F.R.S., £50.

Miss Marietta Pallis: Instalment of cost of her paper on *Plav*, £30.

Thomas Henry Riches, Esq.: Dr. A. R. Wallace's library on Natural History.

Sir Frank Crisp, Bt.: New shelving for Wallace's Volumes.

1916

Mr. E. Heron-Allen: Contribution to cost of paper on Foraminifera of N.W. Scotland, £44.

Messrs. H. Takeda and C. West: Contribution towards the illustration of their paper, £40.

Royal Society: Contribution towards the illustration of two papers by Prof. Dendy, £40.

The same: Contribution towards Mr. Swynnerton's paper on Form and Colouring, £70.

The High Commissioner for the Union of South Africa, per Dr. J. D. F. Gilchrist, for the illustration of his paper on *Jasus Lalandii*, £30.

Miss Marietta Pallis: Balance of cost of her paper on *Plav*, £90 16s. 6d.

Sir Frank Crisp, Bt.: Phototyped copy of Dioscorides from the 'Codex Anicæ Julianæ' at Vienna.

1917

British Ornithologists' Union, etc.: Contribution towards cost of Mr. H. N. Ridley's paper, £20.

The Royal Society: Second contribution towards the printing of Mr. C. F. M. Swynnerton's paper on Form and Colouring, £75.

Sir Frank Crisp, Bt.: 'Lindenia', Ghent, 1891-1901. 17 vols. sm. fol.

1919

Dr. B. Daydon Jackson: MS. index to Linnean Society's Journal, Botany, vols. xxi-xl (1884-1912) and the botanic entries in the 'Proceedings' for the same period.

1920

The Royal Society: Third contribution towards the printing of Mr. C. F. M. Swynnerton's paper as above, £50.

The High Commissioner for the Union of South Africa, for the printing of Dr. J. D. F. Gilchrist's paper on *Jasus Lalandii*, Part II, £60.

1921

The Percy Sladen Memorial Fund: Additional Grant in aid of publication of 'Transactions', 2nd ser., Zoology, vol. xvii, part 4, £72 10s.

The same: Grant in aid of publication of four papers on the Houtman Abrolhos Islands, £100.

The Royal Society: Donation in aid of papers by Mr. N. E. Brown and Mr. S. L. Moore, £90.

Dr. W. Rushton Parker: Donation of a large series of portraits of Naturalists and Persons after whom Genera have been named, and work on rearrangement and annotation of the entire collection.

Prof. C. S. Sargent, F.M.L.S.: Eight volumes issued by the Arnold Arboretum including 'The Bradley Bibliography'.

Dr. B. Daydon Jackson: MS. Catalogue of each sheet in the Linnaean Herbarium; bound in two volumes folio.

1922

The late Sir Joseph Hooker: Donation of his Medals and Decorations. (Reversion to Linnean Society on Lady Hooker's decease.)

Anonymous donation in aid of publication of the late Dr. E. A. Newell Arber's paper, entitled 'Critical Studies of Coal-Measure Plant-impressions', £60.

The Percy Sladen Memorial Fund: Cost of printing and illustrating 'Transactions', 2nd ser., Zoology, vol. xviii, pt. 1.

1923

Dr. W. Rushton Parker: (1) Donation of Oxford New English Dictionary; vols. i-x, 1888-1928, and Supplement, 1933, 4to. (2) Encyclopaedia Britannica: ed. XI, Cambridge, 1920-2. 32 vols. 4to.

E. Heron-Allen, Esq., F.R.S.: Contribution of £25 towards the cost of paper on the Foraminifera of Lord Howe Island.

1924

The Percy Sladen Memorial Fund: Cost of printing and illustrating 'Transactions', 2nd ser., Zoology, vol. xviii, pt. 2.

1925

Mr. Reginald Cory: New Presidential Chair, emblazoned with the Arms of the Society.

1926

Subscription portrait of Dr. B. D. Jackson, R.N.O.

Mr. A. D. Michael: A large number of Books and Pamphlets from his Library.

The late Mr. A. O. Walker: £200 free of Legacy Duty.

An Anonymous Donor: £100 to establish a Fellowship in memory of the late Prof. E. A. Minchin, F.R.S., Sec.L.S.

The Royal Society: Donation in aid of publication of Mr. G. P. Farran's paper on Biscayan Plankton.—Part 14. The Copepoda, £60.

The late Mr. Frank Morey: £100 free of Legacy Duty.

The late Mr. George Lewis: Books and pamphlets on Entomological subjects.

Capt. E. G. Spencer-Churchill: A copy of a collotype reproduction of 'The herbal of Apuleius Barbarus . . . (MS. Bodley 130)'.

The Percy Sladen Memorial Fund: Cost of printing and illustrating 'Transactions', 2nd ser., Zoology, vol. xix, pt. 1.

1927

The late Mrs. Mary Anne Stebbing : £100 less Legacy Duty.

1928

Carnegie United Kingdom Trust : £666 13s. 4d. for purchase of books.

The Royal Society : £160 (£85 in aid of the publication of Dr. G. Enderlein's paper on *Die Copeognathen der Seychellen*), £75 in aid of Mr. C. V. B. Marquand's paper on 'The Botanical Collections made by Capt. F. Kingdon Ward in the Eastern Himalaya and Tibet in 1924-5').

1929

Carnegie United Kingdom Trust : £666 13s. 4d. for purchase of books.

The Percy Sladen Memorial Fund : £100 in aid of the publication of papers on the Fauna of the Paraguayan Chaco.

Carnegie Trust for the Universities of Scotland : £28 in aid of the publication of papers on the Fauna of the Paraguayan Chaco.

1930

Carnegie United Kingdom Trust : £666 13s. 4d. for purchase of books.

An Anonymous Donor : £23 towards the purchase of an Epidiascope.

The Royal Society : £100 in aid of the publication of Mr. H. W. Pugsley's paper, 'A revision of the British *Euphrasiae*' and Dr. T. A. Sprague's paper, 'The Herbal of Leonhart Fuchs'.

Mrs. B. Daydon Jackson (the late) : valuable reversion under her Will after three life-tenants shall have died.

Mr. B. B. Woodward (the late) and Mr. A. S. Kennard : a portion of Mr. Woodward's scientific library and reversion of the remainder.

1931

Miss E. C. Hatchett Jackson : Bust of Charles Hatchett, F.L.S., by Chantrey.

Major Vivian Seymer : Volumes from the Library of Henry Seymer.

- Exors. of the late Dr. E. J. Bles: Donation in aid of colour collotype plates to illustrate Dr. Karl Peter's paper on *Xenopus laevis*, £100.
- Dr. Francis Pierrepont Barnard: Bequest of Sir James E. Smith's seal, his collection of seal impressions, and some portraits.
- The Percy Sladen Memorial Fund: Cost of printing and illustrating 'Transactions', 2nd ser., Zoology, vol. xix, pt. 2.

1932

- Mr. Francis Druce: Donation towards the cost of new books, £50.
- The Royal Society: Donation in aid of the publication of papers resulting from Dr. Worthington's Expedition to the East African Lakes, £75.
- Subscription portrait of the late Professor Julius von Sachs, F.M.L.S.
- Cambridge Expedition to the East African Lakes, 1930-31 (Dr. E. B. Worthington, leader).—Unexpended balance of expedition funds, for the publication of the scientific results, £175.
- Carnegie Institution of Washington: Donation of a considerable number of its publications.

1933

- The Royal Society: Donation in aid of the publication of Dr. H. Boschma's paper 'The Rhizocephala in the collection of the British Museum', £60.
- The Percy Sladen Memorial Fund: Cost of printing and illustrating 'Transactions', 2nd ser., Zoology, vol. xix, pt. 3.

1934

- Mr. Francis Druce: Certain legal expenses connected with the Society's interest in the Will of the late Mrs. Jane Jackson, £33 14s.
- Mr. Warren R. Dawson, F.R.S.E.: Compilation of 'Catalogue of the Manuscripts in the Library of the Linnean Society of London.—Part 1. The Smith Papers'; and cost of binding the additional series of correspondence, etc.
- The Royal Society: Donation in aid of the publication of Dr. G. S. Carter's paper, 'The fresh waters of the rain-forest areas of British Guiana', and Mr. H. N. Dixon's paper, 'A contribution to the Moss flora of Borneo', £85.

The Misses Phipps Tiarks : Copy of portrait of N. B. Ward, F.R.S., F.L.S., by an unknown artist ; engraving after Knight's portrait ; drawing of Ward's conservatory ; and his ' Pitt Club ' medal.

1935

The Royal Society : Donation in aid of the publication of Mr. W. T. Stearn's paper, '*Epimedium* and *Vancouveria*, a monograph', and Dr. F. K. Sparrow's paper, 'A contribution to our knowledge of the Aquatic Phycomycetes of Great Britain', £150.

TREASURER'S ACCOUNTS FOR THE

(Presented at the Anniversary

*Receipts and Payments of the Linnean Society***General**

	RECEIPTS	£	s.	d.	£	s.	d.
To Balance at 1 May 1934		658	16	7			
„ Cash in hand		16	5	6			
					675	2	1
„ Admission Fees					36	0	0
„ Arrears of Annual Contributions		37	18	0			
„ Annual Contributions for year		2415	0	0			
Do. in advance		120	0	0			
					2572	18	0
„ Interest on Investments (including Income Tax recovered)					307	14	4
Do. Deposit					7	10	6
„ Sales of Publications :—							
Transactions		22	2	8			
Journals		154	8	7			
Proceedings		8	0	5			
Library Catalogue		1	18	9			
Catalogue of Manuscripts		7	7	6			
					193	17	11
„ Donations in aid of Publications					85	0	0
„ Donations for General Purposes					1	0	0
„ Miscellaneous Receipts					37	6	6
					<u>£3916</u>	<u>9</u>	<u>4</u>

Library

	RECEIPTS	£	s.	d.
To Balance 1 May 1934		29	5	7
„ Interest on Investments (including Income Tax recovered)		50	19	7
„ Transferred from General Account		450	0	0
		<u>£530</u>	<u>5</u>	<u>2</u>

Fellows Postal

	£	s.	d.
To Balance at 1 May 1934	54	17	7
„ Deposits during year	14	17	3
	<u>£69</u>	<u>14</u>	<u>10</u>

YEAR ENDED 30 APRIL 1935.

Meeting, 24 May 1935.)

from 1 May 1934 to 30 April 1935.

Account

PAYMENTS	£	s.	d.	£	s.	d.
By Coal, Electric Current, and Gas.....				84	1	6
„ Furniture.....				8	5	6
„ Repairs: Sundry				14	5	5
„ Taxes and Insurance				62	8	9
„ Miscellaneous Printing and Stationery.....				138	7	9
„ Petty Expenses (including Tea and Postage)				179	0	8
„ Publications:—						
Printing	757	11	10			
Illustrations.....	123	5	7			
Distribution.....	70	18	3			
				951	15	8
„ Salaries and Wages, etc.				1167	0	0
„ Transferred to Library Account				450	0	0
„ Zoological Record: Donation for 1934 volume				15	0	0
„ Purchase of £93 4s. 10d. 3½ per cent. Conversion Stock (Staff Pension Fund)				100	0	0
„ Linnean Medal				15	0	0
„ Balance at 30 April 1935:—						
Current Account at Bank.....	65	0	3			
Deposit „ „	250	0	0			
„ „ Post Office Savings						
Bank	400	0	0			
Cash in hand	16	3	10			
				731	4	1
				£3916	9	4

Account

PAYMENTS	£	s.	d.
By Books	19	4	5
„ Periodicals.....	319	19	6
„ Binding	98	17	3
„ Balance at 30 April 1935	92	4	0
	£530	5	2

Account

	£	s.	d.
By Postage during year.....	8	5	2
„ Balance at 30 April 1935.....	61	9	8
	£69	14	10

Separate Account

To Balance at 1 May 1934 :—		£	s.	d.
Westwood Fund	£20	6	0	
Trail Award Fund	14	11	8	
Crisp Award Fund	54	4	7	
Hooker Lecture Fund	65	9	9	
Goodenough Fund	8	15	2	
Minchin Fellowship Fund	5	5	0	
				168 12 2
Interest on Investments (including				
Income Tax recovered) :—				
Westwood Fund	£12	0	4	
Trail Award Fund	3	10	0	
Crisp Award Fund	7	10	0	
Hooker Lecture Fund	22	19	5	
Goodenough Fund	9	15	1	
Minchin Fellowship Fund	5	2	6	
Staff Pension Fund	32	12	11	
				93 10 3
				£262 2 5
By Goodenough Fund :—				
Transferred to Annual Contributions				17 10 0
Minchin Fellowship Fund :—				
Transferred to Annual Contributions				4 0 0
Staff Pension Fund :—				
Purchase of £30 18s. 4d. 3½ per cent.				
Conversion Stock				32 12 11
Balance at 30 April 1935 :—				
Westwood Fund	£32	6	4	
Trail Award Fund	18	1	8	
Crisp Award Fund	61	14	7	
Hooker Lecture Fund	88	9	2	
Goodenough Fund	1	0	3	
Minchin Fellowship Fund	6	7	6	
				207 19 6
				£262 2 5

General Account

£	s.	d.	General Account
1000	0	0	Metropolitan 3 per cent. Stock 1941
1200	0	0	India 3 per cent. Stock
1000	0	0	Eastern Bengal Railway 4 per cent. Irredeemable Debenture Stock
1000	0	0	Great Western Railway 4 per cent. Debenture Stock
312	0	0	London Midland & Scottish Railway 4 per cent. Preference Stock
3295	0	0	4½ per cent. Conversion Stock 1940-44

Library Account

£	s.	d.	Library Account
450	0	0	Forth Bridge Railway 4 per cent. Stock (Bentham Bequest)
200	0	0	4½ per cent. Conversion Stock 1940-44 (Walker and Morey Bequests)
530	0	0	East Indian Railway 3½ per cent. Debenture Stock (Tagart Bequest)
88	9	8	London County 5 per cent. Stock 1940-60 (Stebbing Bequest)

Separate Account

			<i>Separate Account</i>					
£	s.	d.	Metropolitan Water Board 3 per cent. "B" Stock (Westwood Fund)			@ 99		
£1063	10	7	232	5	0	ditto	@ 99	
			667	14	2	ditto	(Hooker Lecture Fund)	@ 99
			163	11	5	ditto	(Goodenough Fund)	@ 99
			100	0	0	New South Wales 3½ per cent. Stock, 1930-50 (Trail Award Fund)	@ 100	
			300	0	0	2½ per cent. Consolidated Stock (Crisp Award Fund)	@ 88½	
£315	4	5	129	10	6	India 3½ per cent. Stock 1931 (Westwood Fund)	@ 97	
			61	18	0	ditto	(Hooker Lecture Fund)	@ 97
			123	15	11	ditto	(Goodenough Fund)	@ 97
			100	0	0	London County 5 per cent. Stock 1940-60 (Minchin Fellowship Fund)	@ 112½	
			946	16	6	3½ per cent. Conversion Stock (Staff Pension Fund)	@ 108	
						(£14 1s. 7d. Ditto, to be transferred on 1 May 1935.)		

FRANCIS DRUCE, *Treasurer.*

We have (in conjunction with the Professional Auditor, who certifies as to all details) audited the Accounts of the Society for the year ended 30 April 1935, and found them correct. We have verified the Investments and Bank Balances.

Dated this 14 May 1935.

W. B. KEEN, Chartered Accountant.

Auditors.

W. T. CALMAN,
J. HUTCHINSON,
N. B. KINNEAR,
D. J. SCOURFIELD,
C. DIVER,
J. RAMSBOTTOM,

ADDITIONS AND DONATIONS

TO THE

LIBRARY

1934-35

Note.—Separate copies of papers which are included in periodicals received by the Library are no longer catalogued. Names of donors are given in square brackets.

- Agostini, Ada.** Risultati di esperimenti di difetto nella regione del blastoporo in embrioni di anfibî Anuri. (Riv. Biol. Vol. 14, 1932, pp. 15.) 8vo. [Professor F. RAFFAELE.]
- Arber, Agnes.** The Gramineae: A study of Cereal, Bamboo, and Grass. Pp. xvii+480. 8vo. Cambridge, 1934.
- Arctica.** Vol. 1→ 8vo. Leningrad, 1933→
- Ashby, Eric.** See Lundegardh, H.
- Barton, B. H., & Castle, T.** The British Flora Medica; a history of the medicinal plants of Great Britain. New Edition by J. R. JACKSON. Pp. xxii+447. 8vo. London, 1877.
- Baur, Erwin.** Von M. HARTMANN. (Naturwissenschaften, Vol. 22, 1934, pp. 258-60.) 4to. [Professor F. E. WEISS.]
- Bavendamm, W.** Die mikrobiologische Kalkfällung in der tropischen See. (Arch. Mikrobiol. Vol. 3, 1932, pp. 205-76.) 8vo. [E. E. DIXON.]
- Bernice P. Bishop Museum.** Bulletin, No. 106→ 8vo. Honolulu, 1933→
- Blackburn, E. P.** A survey of the land and freshwater Mollusca of Northumberland and Durham. (Trans. North. Nat. Union, Vol. 1, 1934, pp. 139-86.) 8vo. [AUTHOR.]
- Blakeslee, A. F.** See Sinnott, E. W.
- Blaringhem, L.** Le perfectionnement des plantes. Pp. 192. 8vo. Paris, 1913. [Professor F. E. WEISS.]
- Les problèmes de l'Hérédité expérimentale. Pp. 317. 8vo. Paris, 1919. [Professor F. E. WEISS.]
- Les transformations brusques des êtres vivants. Pp. 353. 8vo. Paris, 1920. [Professor F. E. WEISS.]
- Blatter, E.** The Palms of British India and Ceylon. Pp. xxviii+600. 8vo. London, 1926.
- Blumea.** Vol. 1→ 8vo. Leiden, 1934→
- Bombay Natural History Society (The).** 1883-1933. Printed in Commemoration of the Golden Jubilee of the Society, 1933. Pp. 102. 8vo. [Bombay, 1934.] [THE SOCIETY.]
- Bower, F. O.** Primitive Land Plants: also known as the Archegoniatae. Pp. xiv+658. 8vo. London, 1935. [AUTHOR.]

- British Museum.** Synopsis of the Contents of the British Museum. Ed. 37. 8vo. *London*, 1838. [TRUSTEES, BRIT. MUS.]
- A Guide to the Exhibition Rooms of the Departments of Natural History and Antiquities. Pp. iv+112. 8vo. *London*, 1859. [TRUSTEES, BRIT. MUS.]
- British Museum (Natural History).**
- The London Clay Flora. By E. M. REID and M. E. J. CHANDLER. Pp. viii+561. 4to. *London*, 1933. [TRUSTEES, BRIT. MUS.]
- Catalogue of Fossil Cephalopoda . . . Part IV. The Ammonoidea of the Trias. By L. F. SPATH. Pp. xvi+521. 8vo. *London*, 1934. [TRUSTEES, BRIT. MUS.]
- The Generic Names of Holarctic Butterflies. Vol. 1, 1758-1863. By FRANCIS HEMMING. Pp. viii+184. 8vo. *London*, 1934. [TRUSTEES, BRIT. MUS.]
- A systematic monograph of the Flatfishes (Heterosomata). Vol. 1. Psettodidae, Bothidae, Pleuronectidae. By J. R. NORMAN. Pp. viii+459. 8vo. *London*, 1934. [TRUSTEES, BRIT. MUS.]
- A monograph of the Frogs of the Family Microhylidae. By H. W. PARKER. Pp. viii+208. 8vo. *London*, 1934. [TRUSTEES, BRIT. MUS.]
- A Guide to the Fossil Birds, Reptiles, and Amphibians . . . By W. E. SWINTON. Pp. xii+87. 8vo. *London*, 1934. [TRUSTEES, BRIT. MUS.]
- A Guide to the Fossil Mammals . . . Pp. 84. 8vo. *London*, 1934. [TRUSTEES, BRIT. MUS.]
- Instructions for Collectors: No. 11. Fossils and Minerals. Ed. 5. Pp. 8. 8vo. *London*, 1934. [TRUSTEES, BRIT. MUS.]
- Buller, A. H. R. Researches on Fungi. Vol. 6. Pp. xii+513. 8vo. *London*, 1934. [J. RAMSBOTTOM.]
- Calvert, A. F. Daffodil growing for pleasure and profit. Pp. xix+389. 8vo. *London*, 1929. [AUTHOR.]
- Camus, A. Les Chênes. Monographie du genre *Quercus*. Atlas, Tome 1. [108 Plates.] *Paris*, 1934.
- Carnegie Institution of Washington. Contributions to Palaeontology. Studies of the Pleistocene Palaeobotany of California. By R. W. CHANEY, H. L. MASON, and S. S. POTBURY. Pp. 179. 8vo. *Washington*, 1934. [CARNEGIE INST.]
- Carr, J. W. The Invertebrate Fauna of Nottinghamshire. Supplement. Pp. viii+287. 8vo. *Nottingham*, 1935. [AUTHOR.]
- Castle, T. See Barton, B. H.
- Cavanillesia: *Rerum Botanicarum Acta*. Vol. 1→ 8vo. *Barcinone*, 1928→
- Chaix, E. Les formes topographiques du Parc national suisse. (Jahrb. Schweiz. Alpenclub, Vol. 52, 1917, pp. 212-19.) 8vo. [Dr. R. T. GUNTHER.]
- Chalk, L., & Chattaway, M. M. Measuring the length of vessel members. (*Tropical Woods*, No. 40, 1934, pp. 19-26.) 8vo. [M. M. CHATTAWAY.]
- Factors affecting dimensional variations of vessel members. (*Tropical Woods*, No. 41, 1935, pp. 17-37.) 8vo. [M. M. CHATTAWAY.]
- Chandler, M. E. J. See **British Museum (Natural History)**. The London Clay Flora.
- Chaney, R. W. See **Carnegie Institution of Washington**.
- Chattaway, M. M. See Chalk, L.
- Chodat, Robert. La Végétation du Paraguay. Résultats scientifiques d'une Mission botanique Suisse au Paraguay. Premier fascicule. Pp. 290. 8vo. *Genève*, 1916. [Professor F. E. WEISS.]
- See Fischer, Ed.
- Chowdhury, K. A. The identification of the Commercial Timbers of the Punjab. Pp. vii+70. 8vo. *Delhi*, 1934.

Clarke, S. H. *See* Rendle, B. J.

Consett, M. A tour through Sweden, Swedish-Lapland, Finland and Denmark . . . Pp. xiv+157. 4to. London, 1789.

[Professor F. E. WEISS.]

Cook, O. F. Beginnings of rubber culture. (Journ. Heredity, Vol. 19, 1928, pp. 204-15.) 8vo. [H. N. RIDLEY.]

Cotton, C. W. E. Handbook of commercial information for India. Pp. viii+383. 8vo. Calcutta, 1919.

Dawson, Warren R. Studies in the Egyptian medical texts I-III. (Journ. Egypt. Archaeol. Vol. 18, pp. 150-4; Vol. 19, pp. 133-7; Vol. 20, pp. 41-6, 1932-4.) 4to. [AUTHOR.]

Dawson, Warren R. *See* Linnean Society of London (The).

Dinsmore, J. E. *See* Post, G. E.

Discovery Reports. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Vol. 1→ 4to. Cambridge, 1929→ [Continued :—]

Vol. 9 (1934).

The sub-Antarctic forms of the Great Skua (*Catharacta skua skua*).

By J. E. HAMILTON. Pp. 161-74.

The marine deposits of the Patagonian Continental Shelf. By L. HARRISON MATTHEWS. Pp. 175-206.

The development of *Rhincalanus*. By ROBERT GURNEY. Pp. 207-14.

Nemerteans from the South Atlantic and Southern Oceans. By J. F. G. WHEELER. Pp. 215-94.

The Sea-floor Deposits.—1. General Characters and Distribution. By E. NEAVEVERSON. Pp. 295-350.

On the stock of Whales at South Georgia. By J. F. G. WHEELER. Pp. 351-72.

Title-page, etc. Pp. i-vi.

Vol. 10 (1934):—

Foraminifera. Part III. The Falklands Sector of the Antarctic (excluding South Georgia). By ARTHUR EARLAND. Pp. 1-208.

The Falkland Species of the Crustacean Genus *Munida*. By G. W. RAYNER. Pp. 209-45.

[THE DISCOVERY COMMITTEE.]

Earland, Arthur. *See* Discovery Reports. Vol. 10.

Elisha Mitchell Scientific Society. Journal, Vol. 1→ 8vo. Raleigh, N.C., 1884→

Ellis, David. Sulphur Bacteria. Pp. ix+261. 8vo. London, 1932.

Ernst, A. Das biologische Krakatauprobem. Pp. 187. 8vo. Zürich, 1934. [AUTHOR.]

Fairchild, D. Dr. Ridley of Singapore and the beginnings of the rubber industry. (Journ. Heredity, Vol. 19, 1928, pp. 193-203.) 8vo.

[H. N. RIDLEY.]

Fernald, M. L. *Potentilla canadensis* and *P. simplex*. (Rhodora, Vol. 33, 1931, pp. 180-91. 8vo. [AUTHOR.]

— Types of some American species of *Elymus*. (Rhodora, Vol. 35, 1933, pp. 187-98.) 8vo. [AUTHOR.]

— The Type of *Teucrium canadense*. (Rhodora, Vol. 35, 1933, pp. 392-5.) 8vo. [AUTHOR.]

Fischer, Ed. L'œuvre scientifique de Robert Chodat. (Bull. Soc. Bot. Genève, Vol. 25, 1933, pp. 11.) 8vo.

[Professor F. E. WEISS.]

Forrest, H. E. The Atlantean Continent . . . Pp. 328. 8vo. London, 1933. [With MS. corrections by the author.] [AUTHOR.]

Fortsschritte der Botanik. Bd. 1→ 8vo. Berlin, 1932→

Fritsch, F. E. The structure and reproduction of the Algae. Vol. 1. Pp. xvii+791. 8vo. Cambridge, 1935. [AUTHOR.]

- Gimlette, J. D. Malay Poisons and Charm Cures. Ed. 2. Pp. xii+260. 8vo. *London*, 1923.
- Guimarães, J. d'A. Orchidiographia Portugueza. Pp. 94. 8vo. *Coimbra*, 1887. [P. M. HALL.]
- Gunther, R. T. Oxford and the History of Science... Inaugural Lecture delivered in the Examination Schools, 25 October 1934. Pp. 49. 8vo. *London*, 1934. [AUTHOR.]
- Gurney, Robert. See *Discovery Reports*. Vol. 9.
- Haasis, F. W. Diametral changes in Tree Trunks. Pp. 103. 8vo. *Washington*, 1934. [CARNEGIE INST.]
- Hamilton, J. E. See *Discovery Reports*. Vol. 9.
- Hartmann, M. See Baur, Erwin.
- Hemming, F. See *British Museum (Natural History)*. The generic names of the Holarctic Butterflies.
- Hjort, Johan. The Restrictive Law of Population. Huxley Memorial Lecture 1934. Pp. 46. 8vo. *London*, 1934. [IMP. COLL. SCI. & TECHN.]
- Houghtaling, H. See Sinnott, E. W.
- Hutchinson, J. The Families of Flowering Plants: II. Monocotyledons; arranged according to a new system based on their probable phylogeny. Pp. xiii+243. 8vo. *London*, 1934. [AUTHOR.]
- Huxley Memorial Lecture. See Hjort, Johan.
- Jackson, J. R. See Barton, B. H.
- Kapur, S. N. A manual on the air seasoning of Indian timbers. Pp. v+113. 8vo. *Delhi*, 1934. [AUTHOR.]
- Khanna, L. P. *Cyathodium cavernarum* Kunze, from Burma. (*Journ. Burma Res. Soc.*, Vol. 16, 1927, pp. 227-9.) 4to. [AUTHOR.]
- The morphology of *Cyathodium tuberosum* Kashyap. (*Journ. Burma Res. Soc.*, Vol. 17, 1927, pp. 270-82.) 4to. [AUTHOR.]
- Linnean Society of London (The). Catalogue of the Manuscripts in the Library of the Linnean Society of London.—Part I. The Smith Papers (The Correspondence and Miscellaneous Papers of Sir James Edward Smith, M.D., F.R.S., First President of the Society). By WARREN R. DAWSON, F.R.S.E. Pp. 114. 4to. *London*, 1934.
- Ludi, W. Probleme der botanischen Forschung in den Alpen. (*Jahrb. Schweiz. Alpenclub*, 1917, pp. 179-94.) 8vo. [Dr. R. T. GUNTHER.]
- Lundegårdh, H. Environment and plant development, being "Klima und boden in ihrer wirkung auf das Pflanzenleben." Translated and edited from the 2nd German edition by ERIC ASHBY. Pp. xii+330. 8vo. *London*, 1931. [Dr. ERIC ASHBY.]
- Martin, Isa. H., edited by. The Field-Club Flora of the Lothians by the Botanical Committee of the Edinburgh Natural History Society. Pp. xix+318. 8vo. *Edinburgh*, 1934. [THE EDITOR.]
- Mason, H. L. See *Carnegie Institution of Washington*.
- Matthews, L. Harrison. See *Discovery Reports*. Vol. 9.
- Meunissier, A. Résumé des Travaux de la Section des Etudes scientifiques pendant l'année 1933. (*Bull. Soc. Nat. Hort. France*, 1934, pp. 13.) 8vo. [AUTHOR.]
- Molisch, Hans. Erinnerungen und Welteindrücke eines Naturforschers. Pp. xii+232. 8vo. *Wien*, 1934. [Professor F. E. WEISS.]
- Neaverson, E. See *Discovery Reports*. Vol. 9.
- Needham, J. A History of Embryology. Pp. xviii+274. 8vo. *Cambridge*, 1934.
- Norman, J. R. See *British Museum (Natural History)*. A systematic monograph of the Flatfishes (Heterosomata). Vol. 1.
- Nutman, F. J. The root-system of *Coffea arabica*. (*Empire Journ. Exper. Agric.* Vol. 1, 1933, pp. 271-96.) 8vo. [AUTHOR.]
- Olteanu, R. Etude monographique sur *Hibiscus esculentus*. Pp. 71. 8vo. *Berne*, 1933. [Professor F. E. WEISS.]

- Osborn, H. F.** The Titanotheres of Ancient Wyoming, Dakota, and Nebraska. Vols. 1 & 2. Pp. xxiv+701; xi+702-953. 4to. Washington, 1929. [AUTHOR.]
- Parker, H. W.** See **British Museum (Natural History)**. A monograph of the Frogs of the Family Microhylidae.
- Pearson, R. S.** Commercial guide to the forest economic products of India. Pp. ix+155+xiii. 8vo. *Calcutta*, 1912.
- Pfleiderer, I.** Glimpses into the life of Indian Plants. Pp. vii+205. 8vo. *Mangalore*, 1908.
- Post, G. E.** Flora of Syria, Palestine, and Sinai. Ed. 2. By J. E. DINSMORE. Vol. 2. Pp. xviii+928. 8vo. *Beirut*, 1933.
- Potbury, S. S.** See **Carnegie Institution of Washington**.
- Praeger, R. Lloyd.** The Botanist in Ireland. Pp. xii+587. *Dublin*, 1934.
- Prain, Sir David.** Bengal Plants. Vols. 1 & 2. Pp. 663; 664-1319. 8vo. *Calcutta*, 1903.
- Raunkjær, C.** The life forms of plants and statistical Plant Geography. Pp. xvi+632. 8vo. *Oxford*, 1934.
- Rayner, G. W.** See **Discovery Reports**. Vol. 10.
- Reid, Eleanor M.** Note on some fossil fruits of Tertiary Age from Colombia, South America. (Rev. Geogr. Phys. Vol. 6, 1933, pp. 209-14.) 8vo. [AUTHOR.]
- See **British Museum (Natural History)**. The London Clay Flora.
- Rendle, B. J., & Clarke, S. H.** The diagnostic value of measurements in wood anatomy. (Tropical Woods, No. 40, 1934, pp. 27-37.) 8vo. [M. M. CHATTAWAY.]
- Ridley, H. N.** History of the evolution of the cultivated Rubber Industry. (Bull. Rubber Growers' Assoc. 1928, pp. 7.) 8vo. [AUTHOR.]
- Rocci, U., & Turati, E.** Le Leucanidi del gruppo Zeae Dup. e la cosiddetta "Nottua del Granoturco." (Mem. Soc. Entom. Ital. Vol. 12, 1933, pp. 273-93.) 8vo. [E. TURATI.]
- — — Le Leucanidi del gruppo Zeae Dup. e la cosiddetta "Nottua del Granoturco." Pt. 2. Le specie italiane del genere *Sesamia* Gn. (Mem. Soc. Entom. Ital. Vol. 13, 1934, pp. 22.) 8vo. [E. TURATI.]
- Rotondi, Mario.** Nidificazione del Gruccione (*Merops apiaster* L.) a Castelfusano. (Rassegna Faunistica, Vol. 1, 1934, pp. 7.) 8vo. [Professor F. RAFFAELE.]
- Royal Horticultural Society.** Lily Year Book, 1934. Pp. 117. 8vo. *London*, 1934. [Major F. C. STERN.]
- Russell, E. S.** The Behaviour of Animals: an introduction to its Study. Pp. viii+184. 8vo. *London*, 1934. [Dr. W. T. CALMAN, P.L.S.]
- Saber, A. Hifny.** Variation of the epidermal area of *Senna* leaves. (Quart. Journ. Pharm. Vol. 7, 1934, pp. 161-6.) 8vo. [T. E. WALLIS.]
- The determination of *Senna* Stalk in *Senna*. (Quart. Journ. Pharm. Vol. 7, 1934, pp. 435-9.) 8vo. [T. E. WALLIS.]
- The quantitative determination of powdered Linseed. (Quart. Journ. Pharm. Vol. 7, 1934, pp. 645-53.) 8vo. [T. E. WALLIS.]
- Salter, J. H.** The Flowering Plants and Ferns of Cardiganshire. Pp. vi+182. 8vo. *Cardiff*, 1935. [THE PUBLISHERS.]
- Scherdlin, P.** Contribution à la faune de la Chaîne des Vosges et des régions limitrophes: Coléoptères. (Bull. Soc. Hist. Nat. Colmar, 1935, pp. 65.) 8vo. [AUTHOR.]
- Schroeter, C.** Ueber die Flora des Nationalparkgebietes im Unterengadin. (Jahrb. Schweiz. Alpenclub, Vol. 52, 1917, pp. 170-211.) 8vo. [Dr. R. T. GUNTHER.]
- Sernander, R.** Linné och Lövängen. (Sveriges Natur, 1934, pp. 55-75.) 8vo. [AUTHOR.]
- Shiraki, T., & Sonan, J.** On a new species of Papilionidae, *Papilio maraho* Shiraki et Sonan. (Zephyrus, Vol. 5, 1934, pp. 177-182.) 8vo.

- Sinnott, E. W., Houghtaling, H., and Blakeslee, A. F. The comparative anatomy of extra-chromosomal types in *Datura Stramonium*. Pp. 50 8vo. *Washington*, 1934. [CARNEGIE INST.]
- Smith, M. A. Fauna of British India. Reptilia and Amphibia; Vol. 2, Sauria. Pp. xiii+440. [SECRETARY OF STATE FOR INDIA.]
- Sohn, C. E. Dictionary of the active principles of plants. Pp. vii+194. 8vo. *London*, 1894.
- Spath, L. F. See *British Museum (Natural History)*. Catalogue of Fossil Cephalopoda. Pt. IV.
- Stephenson, T. A. The British Sea Anemones. Vol. 2. Pp. xii+420. (Ray Society Publication.) 8vo. *London*, 1935.
- Stopes, Marie C. On the Petrology of Banded Bituminous Coal. (Fuel in Science and Practice, Vol. 14, 1935, pp. 4-13.) 4to. [AUTHOR.]
- Swinten, W. E. See *British Museum (Natural History)*. A Guide to the Fossil Birds, Reptiles; and Amphibians.
- Taylor, George. An account of the genus *Meconopsis*. Pp. xiii+130. 8vo. *London*, 1934. [FRANCIS DRUCE.]
- Todaro, Augustino. Orchideae Siculae sive enumeratio orchidearum in Sicilia hucusque detectarum. Pp. 135. 8vo. *Panormi*, 1842. [P. M. HALL.]
- Tournefort, Joseph Pitton de. Histoire des plantes qui naissent aux environs de Paris . . . Ed. 2. 2 Vol. Pp. cxvi+421; 546. 12mo. *Paris*, 1725. [A. FORBES SIEVEKING.]
- [Each volume bears the signature of BUFFON on the title-page.]
- Turati, E. Note critiche di Lepidotterologia. (Mem. Soc. Entom. Ital. Vol. 13, 1934, pp. 65-76.) 8vo. [AUTHOR.]
- Novita di Lepidotterologia in Cirenaica. (Atti Soc. Ital. Sci. Nat. Vol. 73, 1934, pp. 159-212.) 8vo. [AUTHOR.]
- Lepidotteri della spedizione di S.A.R. il Duca di Spoleto al Caracorum nel 1929. (Atti Soc. Ital. Sci. Nat. Vol. 72, 1933, pp. 191-208.) 8vo. [AUTHOR.]
- Turati, E. See Rocci, U.
- Usteri, A. Die Pflanzen-sammlung. Pp. 135. 8vo. *Zürich*, n.d.
- Vaughan, T. W. Research in biological subjects at the Scripps Institution of Oceanography. (The Collecting Net, Vol. 9, 1934, pp. 4.) 4to. [AUTHOR.]
- A note on *Orbitoides Browni* (Ellis) Vaughan. (Journ. Paleontology, 1934, pp. 70-2.) 8vo. [AUTHOR.]
- Vredenburg, E. W. A summary of the Geology of India. Ed. 2. Pp. 111. 8vo. *Calcutta*, 1910.
- Wallis, T. E., & Saber, A. Hifny. The quantitative determination of foreign leaves in powdered Drugs. (Quart. Journ. Pharm. Vol. 6, 1933, pp. 655-68.) 8vo. [T. E. WALLIS.]
- Ward, F. Kingdon. A Plant Hunter in Tibet. Pp. 317. 8vo. *London*, [1934]. [AUTHOR.]
- Wheeler, J. F. G. See *Discovery Reports*. Vol. 9.
- Worsley, R. R. Le G. Some East African Essential Oils. (Bull. Imp. Inst. Vol. 32, 1934, pp. 253-70.) 8vo. [W. NOWELL.]
- Worthington, S. & E. B. Inland Waters of Africa. Pp. xix+259. 8vo. *London*, 1933. [DR. W. T. CALMAN, P.L.S.]
- Zeitschrift für Induktive Abstammungs- und Vererbungslehre. Band 67→ 8vo. *Leipzig*, 1934→ [Professor F. E. WEISS.]

INDEX

- Abel, Prof. O., The Pleistocene Mammals and their Relations to the Religion of the Palaeolithic Man of Europe, 58.
- Aberconway, The Lord, elected Councillor, 144.
- Acarine hyperparasitism (Finnegan), 52.
- Accounts, 204.
- Adams, Mrs. H. I., withdrawn, 141.
- Additions to the Library, 208.
- Akroyd, R., elected, 71; certificate read, 24, 31; The British Museum (Natural History) Expedition to the Birunga Volcanoes, 1933-4, 17.
- Alam, Z., admitted, 140; elected, 131; certificate read, 57, 70.
- Allan, Dr. H. H., removed, 141.
- Alpine Desmids from British Columbia, read in title (Carter), 15.
- Amauronematus* Kon. (Hymenoptera Symphyta), the biology of certain species (Miles), read in title, 139.
- American botany, a collection of letters and portraits relating to (Ramsbottom), 56.
- Anagallis arvensis* Linn. and *Anagallis foemina* Mill., the genetics of (Marsden-Jones), 105.
- Anstey, Miss L. M., on Peter Mundy, 37.
- Antelopes, Foetal and Post-natal coats of the subfamily Tragelaphinae (Dollman), 5.
- Araceae, Indian (Fischer), 53.
- Argiope bruennichi* (Marples), 37.
- Armstrong, Dr. J. I., elected, 131; certificate read, 57, 70.
- Ashby, Dr. Eric, elected Councillor, 144; Hybrid vigour in embryos of *Zea* (exhibit), 50.
- Asinus asinus diana*, subsp. nov., a new race of Wild Ass from the Sudan (Dollman), 132.
- Associates, deceased, 140; elected, 131; certificates read, 102, 120.
- Auditors elected, 102.
- Baker, W. E. Watson, elected, 131; certificate read, 88, 102.
- Ballard, F., Leaf-polymorphism in the genus *Polypodium* (exhibit), 50.
- Barnes, Dr. B., elected Councillor, 144.
- Barraud, Capt. P. J., withdrawn, 141.
- Barrington, E. J. W., admitted, 102.
- Beckett, J. E., death reported, 1, 140.
- Benefactions, 198.
- Berkeley, C. J. A., admitted, 120; elected, 25; certificate read, 1, 6.
- Bernhauer, Dr. Max, supplement to Dr. Hugh Scott's paper on Coleoptera, read in title, 70.
- Bexon, Miss D., admitted, 31.
- Bhan, T. N., withdrawn, 141.
- Bidder, Dr. G. P., on algae and sponges, 100.
- Bieberstein, Baron A. Marschall von, thanks on behalf of the German Ambassador, 68.
- Biological classification, the meaning of (Presidential Address), 145-158.

- Birds, attacks on butterflies (Carpenter), 51.
- Birunga Volcanoes, the British Museum (Natural History) Expedition to, 1933-4 (Akroyd), 17.
- Blackburn, Dr. K. B., on the species problem, 112.
- Blakeslee, Dr. A. F., elected, 131; certificate read, 102, 120.
- Blatter, Prof. E., death reported, 1, 140; obituary, 159.
- Blow, T. B., on the Loch Ness 'Monster', 12.
- Bond, Col. C. J., admitted, 70; on dominance in poultry, 81.
- Borneo, the Moss Flora of (Dixon), 16.
- Boschma, Dr. H., on 'Symbiosis' between Invertebrates and unicellular Algae, 96.
- Botanical results of Cambridge Expedition to British Guiana, 1933 (Tutin), 48.
- Botanical Secretary (J. Ramsbottom), elected, 144.
- Botany of the islands in the Gulf of Guinea (Exell), 120.
- Brain, Miss E. D., on geotropism in Lupins, 24.
- Brieger, Dr. F. G., The developmental mechanics of normal and abnormal flowers in *Primula*, 126.
- Brierley, Prof. W. B., on the species problem, 113.
- British Cameroons, Percy Sladen Zoological Expedition, 1932-33 (Sanderson), 25.
- British Guiana, Cambridge Expedition, 1933 (Carter), 46; (Tutin), 48.
- British Museum (Natural History) Expedition to the Birunga Volcanoes, 1933-4 (Akroyd), 17.
- Britton, Dr. N. L., death reported, 2, 140, 143; obituary, 161.
- Brown, Dr. N. E., death reported, 32, 140; obituary, 165.
- Bryozoa from South Africa (O'Donoghue and de Watteville), read in title, 40.
- Bunny, J., withdrawn, 141.
- Burkill, I. H., on mosses, 17.
- Burton, E. St. J., withdrawn, 141.
- Butcher, Dr. R. W., on the species problem, 113.
- Butterflies, selective attacks by birds (Carpenter), 51.
- Bye-Laws, proposed alterations, read, 88, 102; passed, 120.
- Calman, Dr. W. T., elected Councillor and President, 144; Presidential Address, 145-158. (*See also* President.)
- Cambridge Expedition to British Guiana, 1933 (Carter), 46; (Tutin), 48.
- Campbell, Miss M. S., admitted, 88; elected, 71; certificate read, 50, 57.
- Carpenter, Prof. G. D. Hale, elected Councillor, 144; appointed Vice-President, 144; Selective attacks of birds on butterflies: a new set of observations (exhibit), 51; on the Birunga Mountains and Lake Bunyoni, 20.
- Carter, Dr. G. S., The Cambridge Expedition to British Guiana, 1933, 46; on the habitat of *Euryrhynchus*, 136.
- Carter, Dr. Nellie, Alpine Desmids from British Columbia, read in title, 15.
- Cash Statement received and adopted, 140; as audited, 204.
- Chandler, Dr. S. E., Councillor retired, 144.
- Chater, E. H., admitted, 31.
- Chestnut twigs, experiment with (James), 131.
- Chlamydoselachrus anguineus* Garman, the Frilled Shark (Norman), 55.
- Chromosomes in the salivary glands of *Drosophila* (Koller), 55.
- Chromosomes, spiral structure of, in *Tradescantia* (La Cour), 55.
- Cockayne, Dr. L., death reported, 1, 140, 143; obituary, 167.
- Coleoptera associated with the giant Lobelias and arborescent Senecios of eastern Africa (Scott), Supplement (Bernhauer), read in title, 70.
- Collins, Dr. E. J., on plants of the South Orkney Islands, 31.
- Composition Fees, scale of, and proposed alterations in Bye-Laws, 89.
- Cornish birds, Walter Moyle's list (Gunther), 15.
- Cotton, A. D., on the association of algae with sponges, 100.
- Council, election of new members, 144.
- Crustacea *Macrura* (Gordon), 135.
- Dallman, A. A., elected, 131; certificate read, 102, 120.

- Dalziel, Dr. J. M., on the botany of the islands in the Gulf of Guinea, 125; on the rat, *Otomys burtoni*, 28.
- Dangeard, Prof. P.-A.-C., elected, 131; certificate read, 102, 120.
- Darbishire, Prof. O. V., death reported, 2, 140, 143; obituary, 171.
- Dawson, Warren R., The supposed discovery of Unicorns in Tibet, 41.
- Day, Dr. J. H. O., elected, 25; certificate read, 1, 6; Report on the South African Polychaeta, 3.
- Deaths recorded, 140.
- de Vries, Prof. Hugo, death reported, 140, 143; obituary, 172.
- de Watteville, D. See O'Donoghue, C. H.
- Delf, Dr. E. M., Extrusion of oogonia in Fucaceae (exhibit), 51.
- Dickson, Miss M. J., elected, 71; certificate read, 41, 50; floral anatomy of *Glaucium flavum*, 2.
- Diver, Capt. C., elected Auditor, 102; South Haven Peninsula Survey (exhibit), 52.
- Dixon, H. N., A contribution to the Moss Flora of Borneo, 16; Two submerged 'moss-balls' from Lake Inawashiro, Japan (exhibit), 52.
- Dollman, Capt. J. Guy, Foetal and Post-natal coats of the Antelopes of the subfamily Tragelaphinae, 5; A new race of Wild Ass from the Sudan, *Asinus asinus diana*, subsp. nov., 132; Three zoological exhibits, 21; on the Birunga Mountains, 19; on the Loch Ness 'Monster', 12.
- Dominance in poultry, some results of an experiment, with special reference to polydactyly (Fisher), 71.
- Dorward, Sir Arthur R. F., death reported, 2, 140.
- Dowling, Miss R. E., admitted, 140; elected, 131; certificate read, 88, 102; The structure of the ovary in the genus *Plantago* Linn. 1. The British species, 38.
- Drosophila*, chromosomes in the salivary glands of (Koller), 55.
- Druce, Francis, elected Councillor and Treasurer, 144; appointed Vice-President, 144.
- Du Petit-Thouars, Hist. Veg. Isles austr. Afrique, 1805 (Sprague), 57.
- Dymes, T. A., appointed Scrutineer, 141.
- Eco-climatic data for closed evergreen forest in Tropical Africa (Moreau), 40.
- Elephant exhibits (Dollman), 21.
- Elettaria Cardamomum* Maton, floral morphology and cytology (Gregory), 48.
- Elliot, Prof. G. F. Scott, death reported, 1, 140; obituary, 174.
- Elmhirst, R., withdrawn, 141.
- Ewbank, R. B., withdrawn, 141.
- Exell, A. W., The botany of the islands in the Gulf of Guinea, 120.
- Fellows deceased, removed, withdrawn, 140.
- Finnegan, Dr. S., A case of Acarine hyperparasitism in coffee fields in South America (exhibit), 52.
- Firth, J. D., removed, 141.
- Fischer, C. E. C., Specimens of Indian Araceae (exhibit), 53.
- Fisher, Prof. R. A., Some results of an experiment on dominance in poultry, with special reference to polydactyly, 71.
- Flahault, C. H. M., death reported, 57, 140, 143; obituary, 175.
- Floral anatomy of *Glaucium flavum* (Dickson), 2.
- Flying Squirrel (Dollman), 22.
- Ford, E. B., on dominance in poultry, 83.
- Foreign Members, deceased, 140; elected, 131; certificates read, 102, 120.
- Foster, Sir William, on Peter Mundy, 37.
- Foxon, G. E. H., admitted, 140; elected, 25; certificate read, 1, 7.
- Fraser, F. C., Zoological notes from the voyage of Peter Mundy, 1655-56. (b) Sea Elephant on St. Helena; Whale at Greenwich, 32, 33, 35; on the Loch Ness 'Monster', 12.
- Fraser, J., death reported, 41, 140; obituary, 177.
- Friiled Shark, *Chlamydoselachus anguineus* Garman (Norman), 55.
- Fritsch, Prof. F. E., on the association of algae and animals, 96.

- Fry, G., death reported, 1, 140; obituary, 179.
- Fucaceae, extrusion of oogonia in (Delf), 51.
- Gardiner, Prof. J. Stanley, Councillor retired, 144.
- Garside, S., elected Councillor, 144; on obdiplostemony, 137.
- Gates, Prof. R. R., on dominance in poultry and Man, 83; on the species problem, 111.
- Germination of seeds (Hill), 53.
- Gilmour, J. S. L., The General Species Problem, 103.
- Glaucium flavum*, floral anatomy (Dickson), 2.
- Good, Ronald, The real Species Problem, 107.
- Gordon, Dr. Isabella, Luminous shrimps of the genus *Sergestes*, 134; on two rare Crustacea *Macrura*, 135.
- Gould, Lt.-Comm. R. T., on the Loch Ness 'Monster', 10.
- Gramineae, types of leaf-blades (Hubbard), 54.
- Green, Miss M. L., Linné's Öländska Resa (exhibit), 53.
- Gregory, Dr. P. J., The floral morphology and cytology of *Elettaria Cardamomum* Maton, 48.
- Grey, Lt.-Col. C. H., admitted, 88; elected, 71; certificate read, 15, 24.
- Gulf of Guinea, the botany of the islands (Exell), 120.
- Gunther, Dr. R. T., Walter Moyle's list of Cornish birds (1715-17) entered in his copy of Willughby's 'Ornithology', 15.
- Halket, Miss A. C., The bud-pollination and self-fertilization of *Melandrium noctiflorum* Fries (exhibit), 53.
- Hall, P. M., admitted, 1.
- Harmer, Sir Sidney F., on the Loch Ness 'Monster', 11.
- Hedayetullah, Dr. S., removed, 141.
- Hemming, F., admitted, 70; elected, 25; certificate read, 1, 6.
- Hewer, H. R., admitted, 102; elected, 71; certificate read, 24, 31.
- Hill, Sir Arthur W., Germination of *Parinarium* and *Thevetia* as further examples of the germination of seeds enclosed in stony endocarps (exhibit), 53; An exhibit of South African pelargoniums to show the diverse forms of leaf and general habit (exhibit), 54; on the species problem, 118.
- Hill, C. F., elected, 140; certificate read, 120, 130.
- Hingston, Major R. W. G., on British Guiana, 47.
- Hinton, M. A. C., on the Loch Ness 'Monster', 11; on collecting in Africa, 28.
- His Majesty The King, Loyal Address, 119; letter of thanks read, 130.
- Hooker, Sir W. J., Wedgwood medallion of (Ramsbottom), 56.
- Horne, Dr. A. S., and Webb, P. C. R., Cytological preparations illustrating the life history of Plasmodiophorales (exhibit), 54.
- Howard, Sir Albert, admitted, 1.
- Hubbard, C. E., admitted, 102; elected, 71; certificate read, 15, 24; Various types of leaf-blades of the Gramineae (exhibit), 54.
- Hutchinson, Dr. J., elected Councillor, 144; elected Auditor, 102; Evolution of the involucre of bracts in the family Saururaceae (exhibit), 54.
- Hybrid vigour in embryos of *Zea* (Ashby), 50.
- Hyde, H. A., elected Councillor, 144.
- James, Miss H. K., experiment with chestnut twigs (exhibit), 131.
- John, D. Dilwyn, The South Orkney Islands, 29.
- Kemp, Dr. Stanley, elected Councillor and Zoological Secretary, 144; on the Loch Ness 'Monster', 11.
- Kerrich, G. J., admitted, 50; elected, 25; certificate read, 1.
- Kinnear, N. B., Councillor retired, 144; elected Auditor, 102; Zoological notes from the voyage of Peter Mundy, 1655-56. (a) Birds, 32.
- Klein, S. T., death reported, 2, 140; obituary, 180.

- Knight, Dr. M., elected Councillor, 144; appointed Vice-President, 144.
- Koller, Dr. P. Ch., Chromosomes in the salivary glands of *Drosophila* (exhibit), 55.
- La Cour, L., Spiral structure of chromosomes in *Tradescantia* (exhibit), 55.
- Lawton, H. W., *Peripatoides novae-zealandiae* (exhibit), 2.
- Leaf-polymorphism in the genus *Polypodium* (Ballard), 50.
- Lecomte, Prof. H., death reported, 7, 140, 143; obituary, 180.
- Lewis, J. S., admitted, 1.
- Librarian and Assistant Secretary's Report, 140.
- Library, Additions to, 208; report on, 141.
- Linnaean Collections, report on, 141.
- Linnaean species, some (Rendle), 13.
- Linnaeus, Wedgwood medallion of (Ramsbottom), 56; Öländska Resa (Green), 53.
- Linnean Medal awarded (Sir David Prain), 102; presented, 141.
- List of the Society, report on, 140.
- Lloyd, B., admitted, 102; elected, 71; certificate read, 15, 24.
- Loch Ness 'Monster' (Mountain), 7.
- Lolium perenne* Linn. $\times$ *Lolium multiflorum* Lam., the inheritance of a substance in the roots of seedling hybrid derivatives causing a fluorescent reaction (Woodforde), 39.
- Longstaff, Mrs. M. J., death reported, 50, 140; obituary, 183.
- Lowndes, A. G., elected Councillor, 144; on the waters of the British Guiana swamps, 47.
- Loyal Address to His Majesty The King, 119; letter of thanks read, 130.
- Luminous shrimps of the genus *Sergestes* (Gordon), 134.
- MacBride, Prof. E. W., elected Councillor, 144; on the results of the Cambridge Expedition to British Guiana, 47; on dominance in poultry, 82; on Polychaeta, 5; on the Tibetan Unicorn, 44.
- McGillivray, R., withdrawn, 141.
- Mackenzie, K. K., death reported, 41, 140; obituary, 184.
- Marples, Mrs. M. J., Notes on *Argiope bruennichi* and other Pyrenean spiders, 37.
- Marsden-Jones, E. M., The genetics of *Anagallis arvensis* Linn. and *Anagallis foemina* Mill., 105.
- Marsh, Miss F. H. B., admitted, 140; elected, 131; certificate read, 70, 88.
- Maslen, Dr. A. J., withdrawn, 141.
- Meaning of biological classification (Presidential Address), 145-158.
- Melandrium noctiflorum* Fries, bud-pollination and self-fertilization (Halket), 53.
- Miles, Dr. H. W., On the biology of certain species of *Amaurone-matus* Kon. (Hymenoptera Symphyta), read in title, 139.
- Minns, C. F., elected, 140; certificate read, 120, 130.
- Mint, new British (Pugsley), 56.
- Monilia sitophila* in England (Ramsbottom and Stephens), 14.
- Moreau, R. E., Some eco-climatic data for closed evergreen forest in Tropical Africa, read in title, 40.
- 'Moss-balls' from Lake Inawashiro, Japan (Dixon), 52.
- Moss Flora of Borneo (Dixon), 16.
- Mountain, Sir Edward M., The Loch Ness 'Monster', 7.
- Moyle, Walter, list of Cornish birds (Gunther), 15.
- Mukerji, Dr. S. K., death reported, 2, 140; obituary, 185.
- Mundy, Peter, Zoological notes from his voyage, 1655-56 (Kinnear and Fraser), 32.
- Narcissus*, a flower showing an abnormal development of the corona (Williams), 103.
- Nicholas, R. E., withdrawn, 141.
- Norman, J. R., The Frilled Shark, *Chlamydoselachus anguineus* Garman: an addition to the British Fish Fauna (exhibit), 55.
- Obituary Notices, 159.
- O'Donoghue, C. H., and de Watteville, D., Bryozoa from South Africa, read in title, 40.
- Officers elected, 144.

- Offord, J. M., certificate read, 70, 88; death reported, 130.
- Ommanney, Dr. F. D., on the South Orkney Islands, 31.
- Orkney Islands, South (John), 29.
- Otter, G. W., admitted, 50.
- Pariana* (Gramineae), a revision of the genus (Tutin), read in title, 130.
- Parinarium*, germination of (Hill), 53.
- Parker, Dr. W. Rushton, on the creatures found in West Africa by Hanno, 28.
- Patterson, A., elected, 131; certificate read, 102, 120.
- Paulson, R., death reported, 88, 140; obituary, 186.
- Payne, Mrs. M. B., withdrawn, 141.
- Pearse, Dr. H. L., a resistance porometer (exhibit), 55.
- Pease, Michael, on dominance in poultry, 85.
- Pelargoniums, South African (Hill), 54.
- Percy Sladen Zoological Expedition to the British Cameroons, 1932-33 (Sanderson), 25.
- Peripatoides novae-zealandiae*, exhibit (Lawton), 2.
- Persoon, letter from Dawson Turner to William Borrer, junr., concerning his visit to (Ramsbottom), 56.
- Plant species (Turrill), 104.
- Plantago* Linn., the structure of the ovary. 1. The British species (Dowling), 38.
- Plasmodiophorales, cytological preparations illustrating the life history of (Horne and Webb), 54.
- Pleistocene Mammals and their Relations to the Religion of the Palaeolithic Man of Europe (Abel), 58.
- Polychaeta, South African (Day), 3.
- Polypodium*, leaf-polymorphism in (Ballard), 50.
- Pott, R. H., admitted, 88; elected, 71; certificate read, 32, 41.
- Powell-Cotton, Major P. H. G., on a new race of Wild Ass from the Sudan, 134.
- Prain, Sir David, Linnean Medallist, 102, 141.
- Pranker, Dr. T. L., on geotropism and the statolith apparatus, 23.
- President (Dr. W. T. Calman), elected, 144; Presidential Address: The Meaning of Biological Classification, 145-158; appointed Vice-Presidents, 144; appointed Scrutineers, 141; on Mr. Akroyd's collection from the Birunga Mountains, 21; on a collection of manuscripts and portraits mainly relating to American botany, 71; on Antelopes, 6; on Catalogue of Smithian MSS., 46; on the Loch Ness 'Monster', 12; on *Monilia sitophila*, 14; on Palaeobiology, 58; on Polychaeta, 5; on the term 'symmetrical', 16.
- Presidential Address, 145-158.
- Prime, C. T., admitted, 31; elected, 25; certificate read, 7, 15.
- Primula*, developmental mechanics of normal and abnormal flowers (Brieger), 126.
- Pugsley, H. W., The British Robertsonian Saxifrages, read in title, 139; a new British Mint (exhibit), 56; on *Plantago*, 39.
- Pycraft, W. P., on Palaeolithic Man, 70.
- Pyrenean spiders (Marples), 37.
- Raitt, D. S., admitted, 88; elected, 71; certificate read, 32, 41.
- Ramsbottom, J., elected Councillor and Botanical Secretary, 144; a collection of letters and portraits mainly relating to American botany: together with Wedgwood medallions of Linnaeus and Sir William J. Hooker (exhibit), 56; Letter from Dawson Turner to William Borrer, junr., concerning his visit to Persoon (exhibit), 56; on some Linnaean species, 14; on *Plantago*, 39; on the species problem, 117.
- Ramsbottom, J., and Stephens, Miss F. L., *Monilia sitophila* in England, 14.
- Rathbone, Miss May, on fluorescence in *Lolium*, 40.
- Raunkiaer, Prof. C., elected, 131; certificate read, 102, 120.
- Removals of Fellows from List, 141.
- Rendle, Dr. A. B., Some Linnaean species, 13; on the Birunga Mountains, 21; on floral anatomy, 3; on the botany of the islands

- in the Gulf of Guinea, 125; on obdiplostemony, 137; on *Plantago*, 39; on abnormal flowers in *Primula*, 129; on N. B. Ward, 2.
- Resistance porometer (Pearse), 55.
- Rhodes, Rev. P. G. M., death reported, 32, 140; obituary, 187.
- Rhythmic development and radial organization in the flower (Saunders), 136.
- Ricardo, Miss C. K., certificate read, 130, 140.
- Richards, P. W., on the Moss Flora of Borneo, 17.
- Robertson, Prof. R. A., death reported, 50, 140, 143; obituary, 188.
- Robinson, W., death reported, 140, 143; obituary, 189.
- Robson, G. C., withdrawn, 141.
- Rodger, Sir Alexander, withdrawn, 141.
- Rowntree, W. S., on Willughby's 'Ichthyographica', 16.
- Sainsbury, G. O. K., elected, 25; certificate read, 1, 6.
- Salisbury, Prof. E. J., on *Plantago*, 39.
- Sanderson, I. T., elected, 71; certificate read, 32, 41; The Percy Sladen Zoological Expedition to the British Cameroons, 1932-33, 25.
- Sattar, A., removed, 141.
- Saunders, Miss E. R., Rhythmic development and radial organization in the flower, 136.
- Saururaceae, evolution of the involucre of bracts in (Hutchinson), 54.
- Savage, S., on N. B. Ward and exhibit of Wardiana, 2.
- Saxifragas, The British Robertsonian (Pugsley), read in title, 139.
- Scharff, Dr. R. F., death reported, 1, 140, 143; obituary, 190.
- Schweickerdt, Dr. H. G., admitted, 102; elected, 71; certificate read, 15, 24.
- Scott, Dr. Hugh, elected Councillor, 144; Coleoptera associated with the giant Lobelias and arborescent Senecios of eastern Africa, with a Supplement by Dr. Max Bernhauer, read in title, 70.
- Scourfield, D. J., elected Councillor, 144; elected Auditor, 102.
- Scrutineers appointed, 141.
- Secretaries elected, 144.
- Semmens, E. J., elected, 71; certificate read, 50, 57.
- Senn, Prof. G., elected, 131; certificate read, 102, 120.
- Sergestes*, luminous shrimps (Gordon), 134.
- Sewell, Lt.-Col. R. B. Seymour, elected Councillor, 144.
- Sheppard, A. W., appointed Scrutineer, 141.
- Singh, R. S., elected, 25.
- Skene, Prof. Macgregor, elected Councillor, 144; appointed Vice-President, 144.
- Smith, Sir Grafton Elliot, on Pleistocene Mammals and their Relations to the Religion of Palaeolithic Man, 69.
- Smith, H. G., on the associations of unicellular algae, 97.
- Smith, H. H., death reported, 41, 140; obituary, 191.
- Soar, C. D., appointed Scrutineer, 141.
- South African pelargoniums (Hill), 54.
- South African Polychaeta (Day), 3.
- South Haven Peninsula Survey (Diver), 52.
- South Orkney Islands (John), 29.
- Species Problem in Phanerogams, a symposium: The General Problem (Gilmour), 103; The investigation of plant species (Turrill), 104; The genetics of *Anagallis arvensis* Linn. and *Anagallis foemina* Mill. (Marsden-Jones), 105; The real Species Problem (Good), 107.
- Sprague, Dr. T. A., Second edition of *Du Petit-Thouars, Hist. Veg. Isles austr. Afrique, 1805* (exhibit), 57; on floras of Brazil, Guiana and Venezuela, 48.
- Stearn, W. T., admitted, 57; elected, 25; certificate read, 1, 6.
- Stephens, Miss F. L. *See* Ramsbottom, J.
- 'Symbiosis' between Invertebrates and unicellular Algae (Yonge), 90.
- Thevetia*, germination of (Hill), 53.

- Thomas, Dr. H. Hamshaw, Councillor retired, 144; on floral anatomy, 3; on abnormal flowers in *Primula*, 129.
- Tiarks, the Misses Phipps, donation of Wardiana exhibited, 2.
- Tillyard, Dr. R. J., withdrawn, 141.
- Totton, A. K., elected, 25; certificate read, 1, 7.
- Tradescantia*, spiral structure of chromosomes in (La Cour), 55.
- Tragelaphinae, Foetal and Post-natal coats (Dollman), 5.
- Treasurer (F. Druce), annual report, 140; elected, 144.
- Treasurer's Accounts, 204; presented, 140.
- Turner, Dawson, letter to William Borrer, junr. (Ramsbottom), 56.
- Turner, E. P., elected, 131; certificate read, 57, 70.
- Turrill, Dr. W. B., The investigation of plant species, 104.
- Tutin, T. G., Botanical results of the Cambridge Expedition to British Guiana, 1933, 48; A revision of the genus *Pariana* (Gramineae), read in title, 130.
- Unicorns in Tibet, the supposed discovery of (Dawson), 41.
- Vallentin, R., death reported, 7, 140; obituary, 191.
- Vella, Dr. S. L., admitted, 31; elected, 25; certificate read, 1, 7.
- Vice-Presidents, appointed, 144.
- Waight, Miss F. M. O., admitted, 102; elected, 71; certificate read, 41, 50; A quantitative study of geotropism and of the development of the statolith apparatus throughout the life history of the Wheat Plant, 23.
- Walton, G. C., death reported, 15, 140; obituary, 194.
- Warburg, E. F., admitted, 31; elected, 25; certificate read, 1, 6; on the species problem, 113.
- Ward, Capt. F. Kingdon, on the Tibetan Unicorn, 44.
- Ward, N. B., exhibit of Wardiana presented by the Misses Phipps Tiarks (Savage), 2.
- Webb, P. C. R. See Horne, Dr. A. S.
- Weiss, Prof. F. E., Councillor retired, 144; on geotropism, 24; on *Monilia sitophila*, 15.
- Wheat Plant, geotropism and the development of the statolith apparatus (Waight), 23.
- Wild Ass from the Sudan, a new race, *Asinus asinus diana*, subsp. nov. (Dollman), 132.
- Wilkins, W. H., elected Councillor, 144.
- Wilkinson, E. B., death reported, 2, 140.
- Williams, I. A., A *Narcissus* flower showing an abnormal development of the corona (exhibit), 103.
- Willmott, Miss E. A., death reported, 2, 140; obituary, 195.
- Willmott, A. J., on the Loch Ness 'Monster', 12; on the species problem, 110.
- Wilson, Prof. S. E., admitted, 140; elected, 131; certificate read, 88, 102.
- Winckworth, R., elected, 71; certificate read, 15, 24.
- Withdrawals from Fellowship, 141.
- Woodforde, A. H. R., The inheritance of a substance in the roots of seedling hybrid derivatives of *Lolium perenne* Linn. $\times$ *Lolium multiflorum* Lam. causing a fluorescent reaction visible in filter-paper by screened ultra-violet light, 39.
- Woodhead, Dr. T. W., admitted, 140.
- Woodward, Sir A. Smith, on the Loch Ness 'Monster', 12.
- Worthington, Dr. E. B., elected Councillor, 144.
- Yonge, Prof. C. M., 'Symbiosis' between Invertebrates and unicellular Algae, 90.
- Zea*, hybrid vigour in embryos (Ashby), 50.
- Zoological exhibits (Dollman), 21.
- Zoological notes from the voyage of Peter Mundy, 1655-56 (Kinneir and Fraser), 32.
- Zoological Secretary (Dr. Stanley W. Kemp), elected, 144.

ERRATA

- P. 15, Line 14 from bottom. *For Schweickert read Schweickerd.*
P. 17, Line 16 from bottom. *After started add from Kabale.*
P. 17, Line 17 from bottom. *For after more than a month read after
a week.*
P. 17, Line 20 from bottom. *For May read October.*
P. 24, Line 3 from bottom. *For Schweickert read Schweickerd.*
P. 39, Line 7. *For Puglsey read Pugsley.*
P. 56, Line 18 from bottom. *For 1914 read 1814.*
P. 130, Line 6 from bottom, *for Richardo read Ricardo.*

THE LINNEAN SOCIETY OF LONDON.

LIST OF OFFICERS AND COUNCIL.

1934-35.

PRESIDENT.

Dr. William Thomas Calman, F.R.S.

VICE-PRESIDENTS.

Mr. Francis Druce.
Prof. J. Stanley Gardiner, F.R.S.

Dr. H. Hamshaw Thomas, M.B.E.,
F.R.S.
Prof. F. E. Weiss, F.R.S.

TREASURER.

Mr. Francis Druce.

SECRETARIES.

Botanical.

Mr. J. Ramsbottom, O.B.E.

Zoological.

Dr. Stanley Kemp, F.R.S.

COUNCIL.

The Lord Aberconway, C.B.E.
Dr. Eric Ashby.
Dr. W. T. Calman, F.R.S.
Prof. G. D. Hale Carpenter, M.B.E.
Dr. S. E. Chandler.
Mr. Francis Druce.
Prof. J. Stanley Gardiner, F.R.S.
Mr. S. Garside.
Mr. J. Hutchinson.
Mr. H. A. Hyde.
Dr. Stanley Kemp, F.R.S.

Mr. N. B. Kinnear.
Dr. Margery Knight.
Mr. Ashley G. Lowndes.
Prof. E. W. MacBride, F.R.S.
Mr. J. Ramsbottom, O.B.E.
Dr. Hugh Scott.
Dr. Macgregor Skene.
Dr. H. Hamshaw Thomas, M.B.E.,
F.R.S.
Prof. F. E. Weiss, F.R.S.

LIBRARIAN AND ASSISTANT SECRETARY.

Mr. Spencer Savage.

